



NUMBER 6

THE  
EDICAL CLINICS  
OF  
NORTH AMERICA

*The County Medical Society Library*

NOVEMBER, 1941

MILITARY MEDICINE

THREE YEAR CUMULATIVE INDEX

*Volumes 23, 24 and 25*

(1939, 1940 and 1941)

PUBLISHED BI-MONTHLY BY

**W. B. SAUNDERS COMPANY**

PHILADELPHIA AND LONDON

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**JOHNSTONE'S**

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**T**his new book provides a simple yet scientifically exact basis for the diagnosis, prevention and treatment of occupational diseases and for the determination of compensation and liability. It is of the utmost importance to family physicians, industrial physicians, surgeons, public health physicians, safety engineers and all who have to do in any way with the health of those employed in industries.

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Dr. Johnstone takes up in unusual detail the causes of occupational diseases, such as gases, solvents, fumes, metals, dusts, etc. His discussions of the diagnosis of lead and benzol poisoning are outstanding, as are those of diseases arising from cadmium, manganese, selenium and other metals. The chapter on "industrial back" is of great significance, the discussion of hernia, trauma, etc. particularly valuable. In fact, this book gives the medical profession just what it has long wanted—the way it wants it.

**Occupational Diseases.** By RUTHERFORD T. JOHNSTONE, A.B., M.D., Director of Department of Occupational Diseases, Golden State Hospital, Los Angeles. 558 pages, 6" x 9", illustrated. \$7.50  
New Book.

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# THE MEDICAL CLINICS OF NORTH AMERICA

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Volume 25

November, 1941

Number 6

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## SYMPOSIUM ON MILITARY MEDICINE

### FOREWORD

THE first thing to be said about this Military Medicine number of the Medical Clinics of North America is its timeliness. When the whole country has its attention focused upon national defense, it is appropriate that a great medical periodical such as this should devote its space to a symposium on military and naval medicine.

The second thing is the evidence of cooperation on the part of the Medical Corps of the armed services as well as civilian medical men who have all united to furnish the contributions to this number.

There is one other thing that I believe should be emphasized, and that is the importance of military and naval medicine in the success of military operations. One of the wooden frigates of Nelson's time would be an easy victim of its modern counterpart, a light cruiser of our own day. Yet it would be no more helpless than would any military force with an antiquated medical service if it were opposed to one possessed of all the knowledge and organization of the medical department of a modern army or navy.

*Rear Admiral, Medical Corps,  
Surgeon General, United States Navy*



## THE PHYSICIAN IN SELECTIVE SERVICE AND THE ARMY

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UNDER the present emergency, the role of the civilian phys-  
ician in connection with Selective Service and the military  
establishment in general might be divided into four parts:

- I. Duties and Opportunities of the Physician Connected with Selective Service.
- II. The Role of the Physician in Connection with Prehabilitation and Rehabilitation.
- III. Special Requirements for Various Branches of Service.
- IV. Duties and Opportunities of the Civilian Physician When He Becomes a Medical Officer in the Army.

### I. DUTIES AND OPPORTUNITIES OF THE PHYSICIAN CONNECTED WITH SELECTIVE SERVICE

The Selective Training and Service Act authorizes the induction into the Army of 900,000 men per year over a period of five years. These men are selected from all walks of life, except those specifically exempted by the Act.

**Local Examination of Registrants.**—In order that registrants may be properly examined, there have been set up some 6400 *Local Boards*, consisting of three or more members, one of whom is a physician. In addition, there are *Medical Advisory Boards*, composed of groups of specialists, some ten to each board. Then there are the *examining physicians* associated with the local boards, but not members of the board. There are





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many thousands of these, and all of this medical service is voluntary and done without monetary compensation. It is estimated that some 25,000 physicians and dentists are voluntarily giving their services and a portion of their time in connection with Selective Service. This time must, of necessity, be taken either from their recreation or from their families. Either way, they are apparently making a double contribution. This emphasizes the same age-old altruistic attitude of the medical profession.

These examining physicians must be perfectly familiar with the physical requirements of the Selective Service and the Army, which are identical, and are set out in detail in Volume VI of the Rules and Regulations of the Selective Service and MR1-9 of the Army; the letters "MR" standing for Mobilization Regulations.

*Classes of Registrants.*—Examinations by the Selective Service should be very thorough and rigid, as nothing but Class I-A men are accepted by the Army. There are three classifications: I-A; I-B; and IV-F.

The *Class I-B* are men who might be able to do limited military service, and who, in the World War I, were accepted by the Army as such and their remediable defects corrected while in the Army; men with irremediable defects were assigned to duties commensurate with their abilities and were known as limited service men. The *Class IV-F* selectees are those unfitted for any military service.

*Problems Presented by Class I-B.*—It is the Class I-B men who have caused so much dissatisfaction and criticism throughout the nation, for various and sundry reasons. They may have disabilities, such as defective or missing teeth, which do not, in any way, interfere with their usual occupation in civilian life, which do not necessarily show and which are not apparent to the general public; naturally considerable criticism arises when such individuals are rejected, since they appear to be well-nourished, strong, healthy men.

There are also what are known as *borderline* Class I-B men, in connection with whom the question of medical judgment comes into play. The Local Board or the Medical Advisory Board may think that they should be classified as I-A; while the

Army Induction Board may believe they should be classified as I-B. This situation should not be a cause for criticism of either the Local Board or the Induction Board, but nevertheless, it does arouse considerable discontent on the part of the selectee, his family and associates; as he, believing he will be in the Army for an indefinite period of time, has resigned his position or closed out his business, and arranged his financial and family affairs for a protracted absence from home. He has probably been given a good-by celebration or appropriate send-off—and then he returns within a few days. The casual observer does not know the reason. It is a bit difficult to explain; and the Local Board physicians naturally are criticized.

Then there is the other side of this picture where the Local Board has classified a selectee as I-B. This young man may be a scion of an influential family, or he may be politically prominent, or he may be the patient of one of the local physicians; and then the Local Board is criticized for favoritism; and many times the Local Board is between the devil and the deep sea—"They are damned if they do and damned if they don't"—and all of this because of their gratuitous and voluntary services.

These services, however, are fully appreciated by the Selective Service headquarters. They (both National and State) are doing everything possible to show their appreciation and to smooth over as many of the rough places as possible.

There are, at the present time, various measures being considered and tested which cannot be described in detail, since they are still in a formative stage, but which may solve, to a certain extent, these problems of I-B men.

*Medical Advisory Board (Local).*—The Medical Advisory Board, as already stated, consists of specialists. This board is exactly what its name implies and was created for the purpose of assisting the Local Boards in their doubtful cases; for instance, if the Local Board encounters a condition upon which it is not qualified to pass, such as an obscure neuropsychosis or other questionable physical or mental disability, the selectee is sent to the Medical Advisory Board for re-examination and study, and the report is returned to the Local Board. The decision of the Advisory Board as a rule is accepted.

The services of the personnel of these three advisory boards are also purely voluntary and gratuitous, and, as a rule, there is one advisory board for approximately five or six Local Boards. They are placed in advantageous and centralized locations, where they render invaluable service. It is the screen of the advisory boards which, theoretically, should sift out most of the obscure case problems in psychiatry and neuropsychiatry since they have more time and the required specialists, and have available the records of the Local Board with comments. The psychiatric cases are giving more concern to the Selective Service and to the Army than any other one group of cases. Often the diagnosis is extremely difficult. Mistakes are extremely costly; these kinds of cases are of unending expense to the Government as was clearly demonstrated after World War I.

**State Headquarters.**—In addition to the boards already named, there is the *State Medical Officer*, who is, as a rule, a Medical Reserve officer placed on active duty by the Army. He is responsible to the Governor of the State, and his duties consist of coordinating the work of, and cooperating with, the Local Boards. He is the chief medical liaison officer between the National Headquarters and the State Headquarters.

The Selective Service Act decentralized authority, making each State responsible for its quota and for the administration of the law and the rules and regulations based upon it.

**National Headquarters.**—The National Headquarters of Selective Service in Washington has a Medical Division which cooperates with the director and the State medical officers and assists in formulating policies of a medical nature. This division is staffed by a chief and several specialized assistants. Associated with the Medical Division, there have been set up what are known as *Advisory Committees*. One, a general medical council, consists of some six or more outstanding members of the profession, who also serve gratuitously. They meet at stated intervals, discuss medical problems in question and submit recommendations but have no administrative function.

The *Psychiatric Advisory Committee* is composed of outstanding psychiatrists, who function as one of the stated committees; they meet and discuss psychiatric questions. In the

early formative period of the Selective Service program, this Psychiatric Committee, under the leadership of Dr. Harry Stack Sullivan of the William Alanson White Foundation, prepared a pamphlet on psychiatry in its relation to the Army for the guidance of the examining physicians of the various boards. This pamphlet was published as *Medical Circular No. 1* by the headquarters of Selective Service. It is one of the most valuable briefs that could possibly be furnished to any examining physician. In all probability, it has already saved the Government and the taxpayer untold millions of dollars.

Another committee is known as the *Dental Advisory Committee*. The necessity for such a group was clearly demonstrated after the first few thousand examination reports were studied at National Headquarters. Dental defects were shown to be the most prevalent disability causing rejection. By reason of lack of training on the part of the examining physician in dental matters, large numbers of selectees were sent to the induction centers, only to be turned down for dental defects.

To remedy this serious discrepancy between the Local Board and the Induction Center, it was deemed necessary to appoint a dentist to every local board—some 6400 in number. The Dental Advisory Committee, with the aid of the American Dental Association, graciously accepted the responsibility of practically certifying to the fitness of the dentists nominated by their respective State Governments for their respective Local Boards. This committee has also prepared a pamphlet, similar to that on psychiatry, for the guidance of the examining physicians and dentists in the dental examination. This is known as *Medical Circular No. 2 (Dental)* and is proving itself of great value and assistance in the work. In addition, it has been found expedient to appoint a nationally known dentist as a member of the Medical Division of the National Headquarters. He has full supervision of all dental matters and also acts in an advisory capacity to the Chief of the Medical Division.

## II. THE ROLE OF THE PHYSICIAN IN CONNECTION WITH PRE-HABILITATION AND REHABILITATION

Selective Service has revealed to the country the appalling state of the lack of health. More than 40 per cent of the young

men of the country between the ages of twenty-one and thirty-six years are found unfit for service. Hence various ways and means are being considered for the correction of remediable defects and for improving the physical fitness of registrants and of people in general. This program may, with advantage, be divided into two parts known as *Prehabilitation* and *Rehabilitation*.

**Prehabilitation.**—Prehabilitation is a new word coined by one of us (L. G. R.) at National Headquarters. As the name itself suggests, it advises every registrant to have a complete physical and dental check-up before appearing for his examination at the Local Board. This check-up is to be made, if the registrant is financially able, by his family physician or dentist; if not, then by some appropriate local or Federal agency. A Certificate of Prehabilitation from his physician will indicate that the registrant has voluntarily submitted himself and requested prehabilitation for the purpose of showing his patriotism and doing his utmost to render himself fit for examination and for service to the Government; this certificate is to be presented to the Local Board at the time of examination and also to the Army in the event of induction.

It is believed that, if this program were carried out in its entirety, the number of Class I-B men would be very materially decreased, since it has been estimated that approximately 50 per cent of I-B defects are remediable to such an extent that they could be reclassified as I-A.

This plan of prehabilitation is one of education. It informs each registrant as to what is expected of him and attempts to direct him to the proper source of help.

It is further proposed to notify each registrant personally of this plan and tell him how it can be accomplished, by appropriate information attached to his questionnaire.

**Rehabilitation.**—Rehabilitation concerns registrants who have already been classified by the Local Board and put in Class I-B or in a lower class. This is a very important subject and is now being considered by many governmental agencies, especially those connected with Federal Security, such as the United States Public Health, the National Youth Administration; and by outside agencies, like the American Legion and

the National Red Cross. It is of greatest concern to the Selective Service and in fact of very great concern to the country at large.

Since rehabilitation concerns registrants, it obviously comes under the scope of Selective Service. Hence, Selective Service has offered a plan whereby it is hoped that the registrant himself, his family doctor and dentist, the appropriate consultants, the hospitals and clinics of each community and the Federal and social agencies will each and all play their part.

The questions concerning who is to accomplish rehabilitation, and who is to pay for it, have not yet been settled. Of course, the ideal method would be to have the registrant himself voluntarily have his remediable defects corrected and then report to the Local Board. If it is not done on a voluntary basis, shall the National Government then make it compulsory and furnish funds for its administration?

A proposal has been made that Rehabilitation Committees be set up in every State and locality as an integral part of or in cooperation with the local Selective Service agencies and that State grants by the Federal Government finance the cost of rehabilitation of the registrant.

This plan provides that the Selective Service set-up as it now exists be utilized nationally, in each and every State and in all local communities, to determine the need for prehabilitation and rehabilitation, the nature of the remedy and the organization best fitted to carry out the treatment necessary. This plan is now being accorded special consideration by Mr. Paul V. McNutt, the Coordinator of Health and Welfare Activities, by the American medical and dental professions and by all the Federal and social agencies.\*

Any plan that accomplishes the successful rehabilitation of registrants will at once be recognized as of national importance and in all probability will lead to the establishment of rehabilitation centers on a national basis. It would therefore

\* Since preparation of this article, there has been some change in the general conception of rehabilitation; it now seems likely the problem will fall under the jurisdiction of the Social Security Agency directed by Mr. Paul V. McNutt in connection and cooperation with organized medicine. Various plans are in operation throughout the country to determine the approximate cost of the project; however, there is nothing absolutely definite at present.



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The questions concerning who is to accomplish rehabilitation, and who is to pay for it, have not yet been settled. Of course, the ideal method would be to have the registrant himself voluntarily have his remediable defects corrected and then report to the Local Board. If it is not done on a voluntary basis, shall the National Government then make it compulsory and furnish funds for its administration?

A proposal has been made that Rehabilitation Committees be set up in every State and locality as an integral part of or in cooperation with the local Selective Service agencies and that State grants by the Federal Government finance the cost of rehabilitation of the registrant.

This plan provides that the Selective Service set-up as it now exists be utilized nationally, in each and every State and in all local communities, to determine the need for prehabilitation and rehabilitation, the nature of the remedy and the organization best fitted to carry out the treatment necessary. This plan is now being accorded special consideration by Mr. Paul V. McNutt, the Coordinator of Health and Welfare Activities, by the American medical and dental professions and by all the Federal and social agencies.\*

Any plan that accomplishes the successful rehabilitation of registrants will at once be recognized as of national importance and in all probability will lead to the establishment of rehabilitation centers on a national basis. It would therefore

\* Since preparation of this article, there has been some change in the general conception of rehabilitation; it now seems likely the problem will fall under the jurisdiction of the Social Security Agency directed by Mr. Paul V. McNutt in connection and cooperation with organized medicine. Various plans are in operation throughout the country to determine the approximate cost of the project; however, there is nothing absolutely definite at present.

men of the country between the ages of twenty-one and thirty-six years are found unfit for service. Hence various ways and means are being considered for the correction of remediable defects and for improving the physical fitness of registrants and of people in general. This program may, with advantage, be divided into two parts known as *Prehabilitation* and *Rehabilitation*.

**Prehabilitation.**—Prehabilitation is a new word coined by one of us (L. G. R.) at National Headquarters. As the name itself suggests, it advises every registrant to have a complete physical and dental check-up before appearing for his examination at the Local Board. This check-up is to be made, if the registrant is financially able, by his family physician or dentist; if not, then by some appropriate local or Federal agency. A Certificate of Prehabilitation from his physician will indicate that the registrant has voluntarily submitted himself and requested prehabilitation for the purpose of showing his patriotism and doing his utmost to render himself fit for examination and for service to the Government; this certificate is to be presented to the Local Board at the time of examination and also to the Army in the event of induction.

It is believed that, if this program were carried out in its entirety, the number of Class I-B men would be very materially decreased, since it has been estimated that approximately 50 per cent of I-B defects are remediable to such an extent that they could be reclassified as I-A.

This plan of prehabilitation is one of education. It informs each registrant as to what is expected of him and attempts to direct him to the proper source of help.

It is further proposed to notify each registrant personally of this plan and tell him how it can be accomplished, by appropriate information attached to his questionnaire.

**Rehabilitation.**—Rehabilitation concerns registrants who have already been classified by the Local Board and put in Class I-B or in a lower class. This is a very important subject and is now being considered by many governmental agencies, especially those connected with Federal Security, such as the United States Public Health, the National Youth Administration; and by outside agencies, like the American Legion and

tions. Special stress is laid on the acuity and accuracy of vision, speed of coordination, perfect equilibrium under all circumstances and, last but not least, temperament. Temperament is given much weight.

**Submarine Service.**—Examinations covering regulations for Submarine Service are also highly specialized and rigid. Special stress is laid on vision, nose and throat, ears, respiratory system and cardiovascular system, and a complete dental examination is conducted by a dental officer. Present or prospective extensive restorations by crowns, bridges, or dentures, or teeth generally unserviceable, are a cause of rejection for the reason that *effective gripping of the mouthpiece of the submarine escape apparatus or "lung" will be interfered with. Pyorrhea alveolaris shall also disqualify. Offensive breath, if persistent, and abnormally excessive or offensive perspiration are sufficient to disqualify.* Candidates presenting a variation in weight of more than 18 per cent above that prescribed in relation to height shall be excluded unless this overweight is mainly due to muscular and bony tissue.

**Deep-sea Diving.**—The most favorable type for deep-sea diving is the young man between twenty and thirty years of age with no tendency to obesity, wiry, of phlegmatic temperament, and capable of withstanding considerable bodily strain. The respiratory exchange in a young man is faster than in a middle-aged man and the circulation is faster. He therefore *desaturates* more rapidly and is less prone to caisson disease. The upper age limit for instruction in the case of medical officers and hospital corpsmen is forty years. *Weight:* Fat absorbs nitrogen in much greater volume than blood and muscle and on decompression gives off its nitrogen more slowly than the other tissues. Consequently, there is a greater tendency to caisson disease in the fat individual. Candidates, therefore, presenting a variation in weight of more than 12 per cent above that prescribed, in relation to height, shall be excluded unless their overweight is largely due to muscle and bone. Applicant must be able to hold his breath after full expiration and inspiration for a period of not less than fifty-five seconds.

It is therefore seen that the examinations of these specialized branches are perforce very rigid and exacting, and re-

become an important factor in bringing about improved public health in the country as a whole.

### III. SPECIAL REQUIREMENTS FOR VARIOUS BRANCHES OF SERVICE

Only those who are fit to fight are acceptable to the armed forces. Every physician who is directly or indirectly connected with the military establishment of the nation, including the Army, Navy and Marine Corps, is vitally interested in the examinations required for entrance into these various services, either in the officer or enlisted personnel.

The general physical and mental requirements of the three Services are somewhat similar and can be found issued in pamphlet form by the Army and Navy, obtainable on request from the War and Navy Departments. The Navy emphasizes vision; the Army insists upon tough bodies and serviceable feet. It has been well said: "*No Arches—No Marches!*"

**Aviation.**—There are specialized departments, such as Aviation, Submarine Service and Deep-sea Diving, which require special and more rigid examinations; for instance in Army Regulations 40-10, under the heading of "Physical Examinations for Flying," you find: "Because of the highly technical character and importance of this examination, it has been found that it can be made properly only by medical officers who have had special instruction and training in this work and who have the special instruments and appliances required. The examination will therefore be made only by flight surgeons and other medical officers who after a special course of instruction are authorized in writing by the Surgeon General to conduct such examinations, and any surgeons or medical officers of the Regular Army, Officers' Reserve Corps, or National Guard who hold such rating from the school of aviation medicine."

Without going into detail, it may be said that only superb and superior men are eligible for flying. Special emphasis is placed on intelligence and education, age, sight, equilibrium and ability to withstand altitude.

**Navy (General).**—Navy Regulations are practically the same as to what type of physicians shall make the examina-

a scientist as well, and he sees the question from both sides. However, there is a very considerable difference between the practice of medicine in the Army and in civil life.

The aims of the medical officer can be divided into two channels. The first and most important objective, from a military standpoint, is securing for the Army a first class fighting man—physically, mentally and morally—and keeping him in that condition. This is especially true if the physician is assigned to combat troops. It may be brutal to make the statement, but the combat units have no use for, and there is no place in them for, a sick man, and he must be immediately evacuated to some suitable organization. It must be the endeavor of the regimental surgeon or the physician who is responsible for the combat troops to conserve insofar as possible the manpower of that organization. Unremitting attention to the health of personnel and to sanitation is necessary.

Pathologic conditions must be found in their incipency in order to remedy them on the spot if possible and thereby prevent the loss of personnel to the organization and the necessity for replacements. It is this objective of the military physician that has brought into being the statement, already referred to, about forgetting that you are a doctor and that you are an Army officer; however, even under these conditions, *if you ever forget that you are a doctor, you will make a very poor medical officer.*

In connection with keeping the Army in fit condition, the medical officer will have to consider the very broad aspects of sanitation, food and communicable diseases within a camp and also in the field. It is along these lines that the ordinary civilian physician will find the surroundings decidedly different, strange and perhaps awkward as compared with civilian life. He will have no Board of Health to refer to, since he is himself the Board of Health and the reporting physician. He may have no municipal water supply, or if such, it may not be of good quality; he will have to constitute himself the Water Department.

Ever since the Spanish-American War the Medical Department has been growing in importance in the Army organization, where it now has very great authority. The rules and regula-

quire certain mental as well as physical characteristics which are not necessarily found in the other branches of the service.

**Medical Reserve Corps.**—From civilian life, the doctor comes into the military establishment through the Medical Corps of the Army and Navy. The following remarks will be dealing almost entirely with the Army. The applicant for Reserve Commission must be between the ages of twenty-one and thirty-five years and a graduate of a Class A medical school. He should have had one year's internship. He must be in excellent physical and mental condition.

After having complied with these requirements and satisfactorily passed a physical and mental examination, he is then commissioned as a First Lieutenant in the Reserve Corps. If he is an outstanding authority or a specialist, and is more or less nationally known, he may, in the time of a great national emergency, be commissioned in higher ranks. During World War I, some men were immediately commissioned as Colonels and even Brigadier Generals.

During an emergency and with a rapidly expanding army, promotions are apt to come quite rapidly. After being commissioned and ordered to active duty, it is quite likely that the new officer will be given a course of instruction in military usages and procedure.

#### IV. DUTIES AND OPPORTUNITIES OF THE CIVILIAN PHYSICIAN WHEN HE BECOMES A MEDICAL OFFICER IN THE ARMY

**As a Physician.**—The civilian physician coming into the military establishment is immediately confronted with the necessity of rearranging to a certain extent his processes of thought and concepts of the practice of medicine. It is probable that, upon his introduction to some of the military personnel, he will be told, "Forget you are a doctor; you are now an Army officer." That statement is resented to a very considerable degree by medical men going into the Army from civilian life and also by the medical officer who has been in the Army for many years and is part of the regular establishment, as is evidenced in an article written by Lt. Colonel A. Fox for "The Military Surgeon," dated January, 1941. We refer to this article because the author is an outstanding Army officer and

duties pertaining to a line officer. This, however, does not take the place of being a doctor, but is in addition to being a doctor.

**As Examining Physician.**—In the preceding paragraphs, we have dealt very largely with what may be termed "Preventive Medicine" in its relation to the health of the military establishment, and we have assumed that men in our care have been carefully examined prior to coming under our jurisdiction. It is possible and very probable that you will be called upon to make an examination of men for admission to the Army, at which time you will be governed by the rules laid down for the examination. A man may be in very good physical condition and free from all evidence of disease and yet not be acceptable to the Army. He may have orthopedic disabilities that would in no wise affect his civilian status. He may have a psychological or psychiatric condition which would not show to any great extent so long as he kept along the even tenure of his way in civilian life, but which would materially affect his ability as a soldier. If you are examining men for entrance, the psychological and psychiatric aspects should be very carefully considered. A keen look-out should be kept for any particular idiosyncrasies or mannerisms that show character or personality defects. Men of this character always cause trouble in group formations and group manner of living, and are a constant source of irritation to their superior officers and a potential expense to the Government in the future.

This, of course, does not take into consideration the examination of men who report to the medical officer at the daily sick call or at other times. All of these examinations are 90 per cent medical and 10 per cent military. The same thing applies to the examination of applicants for the highly specialized Aviation, the requirements for which have been discussed.

**Sick Call.**—In every organization, whether combat or otherwise, there is a *sick call* where all men complaining of any disability, even the disinclination to work, appear for treatment. During this period of the day, you are both an Army officer and a physician.



tions governing the Army, and particularly those governing the Medical Department, are all so worded and construed as to give the medical officer a very enviable position. It is true that he acts only in an advisory capacity to his Commanding Officer, and is, in all probability, a member of his staff. All requests and suggestions for improving the sanitation and health of the command must go through and be issued by the Commanding Officer. All suggestions and advice should be communicated to the Commanding Officer *in writing* and a copy should be kept by the medical officer in order to show that he gave notice of and made the appropriate requests for correction of certain situations. Human nature is so constituted that we are prone, even the best of us doctors, to blame somebody else. The medical officer must be protected and a written copy of his report will be his protection when officials from the Inspector General's Department or from a higher command come to inspect conditions under his command that should have been remedied.

There has been a great deal of discussion and comment, more or less unfavorable, concerning the paper work of the Army and what appears to be an unnecessary amount of paper work in the Medical Department. The necessity for some of it is evident in the situation just related. It is not in order at the present time to go into elaborate detail concerning these requirements of the medical officer, since they will be discussed by others who may be more familiar with the subject.

**As an Army Officer.**—There is another stirring aspect of military life that will confront the civilian practitioner, especially if he is with combat troops or with a medical regiment, and that is the handling of men in formation and in considerable numbers. That is the place where it will become absolutely essential that he becomes an Officer to all intents and purposes. The enlisted personnel that he handles will be identical with all enlisted personnel insofar as attention to the "School of the Soldier" with its emphasis on military formation, duties, obligations and courtesies is concerned. It is self-evident that a person cannot teach something that he does not know; therefore, the medical officer must familiarize himself with certain

ferred from one place to another and from one doctor to another, and therefore the records must be clear, comprehensive and explicit.

In addition to these individual reports, there of course must be the *daily numerical report* concerning the number of incapacitated men under your control. The actual treatment of these men in the base hospitals varies very little from those in the well appointed civilian hospitals. In these hospitals you will find the numerous specialists whom you can fall back upon as in private life, and unless you are the Commanding Officer you are not troubled with the details or general aspects of sanitation.

**With Combat Troops in Action.**—If the medical officer is so fortunate as to be attached to combat troops, he will have to familiarize himself with the fascinating subject of field maneuvers, both during an advance, and perchance during retreat. He will need to study the intricate problem of evacuation of the wounded under shell fire, both during an advance and during a retreat. Troops fight better and feel more satisfied if they are assured of competent and prompt medical service.

In order to perform his duties the medical officer must be able to read military maps and he must familiarize himself with the terrain. He will probably make a reconnaissance survey of proposed advance positions in order to place his medical stations to the best advantage. He will know the location and direction of the secondary roads in order that his ambulances may function with speed and will not interfere with combat units.

He must be able to receive, interpret and transmit combat orders, as well as issue some of his own. He will have to submit his plan of set-up and evacuation to the Commanding Officer prior to the issuance of the final combat orders. All this will have to be done under unusual stress and strain, and probably with insufficient time.

He will have to accustom himself to heartbreaking fatigue, strain, insufficient sleep and irregular meals, and to work surrounded by confusion and noise. His power of concentration and observation must be increased to many times that required in civilian life, in order to meet the needs of the occasion.

**Combat Troop Detail.**—There are many occasions with combat units when it becomes necessary for the physician in charge to do certain emergency work, since he may be far from hospital support. He will need to be skilled in appropriate first aid treatment for major emergencies and disabilities. These remarks do not refer particularly to the casualties of gunfire, for when an organization is engaged in battle you will have a medical line of communication from the front to the rear which ought to be capable of taking care of the necessary steps in management. They refer, rather, to those times when a medical officer may be on detail duty with the detachments, when he will need to call upon and use all the skill and training that he possesses, and work with inferior assisting personnel, generally composed of enlisted men.

**Rear Echelon Service.**—We will now leave—shall we say the front line?—where everyone is presumed to be healthy and normal, and accompany a wounded man or a sick man to the rear echelons. Here we have the intermediate hospitals for temporary and emergency treatment and then further back the stationary hospitals known as either cantonment hospitals or base hospitals, which are presumed to have all modern equipment.

In these spheres of medical military work the medical officer assumes more of his previous relationships and becomes a doctor per se; the military aspects of his work shrink into insignificance with the exception of the *paper work* connected with the hospital service and the reporting of medical facts. In this connection, it is absolutely essential that everything pertaining to the sick man is put down in records that can be easily found and easily transported and in language more clear, concise, comprehensive and convincing than he has ever been accustomed to use before. All unnecessary words should be omitted. All medical discussions should be omitted. These are permanent Government records which may have to be used for ten, fifteen or twenty years, or even longer, after the man is discharged from the Army and the medical officer is returned to private practice. These are the basis for future pensions. There is another feature of these records which must be taken into consideration; namely, that the patient is apt to be trans-

ferred from one place to another and from one doctor to another, and therefore the records must be clear, comprehensive and explicit.

In addition to these individual reports, there of course must be the *daily numerical report* concerning the number of incapacitated men under your control. The actual treatment of these men in the base hospitals varies very little from those in the well appointed civilian hospitals. In these hospitals you will find the numerous specialists whom you can fall back upon as in private life, and unless you are the Commanding Officer you are not troubled with the details or general aspects of sanitation.

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In order to perform his duties the medical officer must be able to read military maps and he must familiarize himself with the terrain. He will probably make a reconnaissance survey of proposed advance positions in order to place his medical stations to the best advantage. He will know the location and direction of the secondary roads in order that his ambulances may function with speed and will not interfere with combat units.

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He will have to accustom himself to heartbreaking fatigue, strain, insufficient sleep and irregular meals, and to work surrounded by confusion and noise. His power of concentration and observation must be increased to many times that required in civilian life, in order to meet the needs of the occasion.

If he is successful, he will be amply repaid by the comments and attitude of the officers and men under his care. He will have the satisfaction of knowing he has helped to keep up the morale of the unit to which he is attached, by demonstrating to the personnel that they will have adequate and prompt medical care when needed.

## MEDICAL ORGANIZATION IN THE PERMANENT CAMP AND IN THE FIELD\*

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THE national defense effort of the American people is, has been and will continue to be one of the most gigantic tasks ever set for them. Now, on July 1, 1941, at the close of the first year of the preparedness program, it is rapidly coming to fruition.

### GENERAL FEATURES OF THE MOBILIZATION PROGRAM

**Allocations of Personnel.**—In order to give a proper conception of the problems presented to the Medical Department of the Army for solution, it is essential to select items from the mobilization machinery and construct of them a foundation. In broad terms, all of the male populace between eighteen and forty-five years of age constitute the Militia of the United States, provided they have able bodies and are not subject to certain exceptions allowed by the National Defense Act. This reservoir of manpower is now subject, within limits, to serve the colors in accordance with the provisions of the Selective Service Act of 1940. The program which was enacted called for a five-year program of training by selected members between the ages of twenty-one and thirty-five years,<sup>†</sup> inclusive, to the number of 800,000 per year, and was distinctly a peacetime preparedness program. On the advice of the War Department, allocations of personnel for the Army were set up as follows:

\* The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the War Department or the military service at large.

† On July 1, 1941, by Act of Congress, the maximum age limit became twenty-eight years.

Regular Army	375,000
National Guard	225,000
Selectees	800,000
Total	1,400,000

The New York Times of June 29, 1941, showed that these figures had been exceeded, for there were then 89,500 officers—53,000 from the Reserve Corps, 21,800 from the National Guard and 14,700 from the Regular Army; while the 1,352,000 enlisted men were allocated as follows: Regular Army, 473,000; National Guard, 267,000; Regular Army Reserves, 18,000; and Selectees, 594,000.

**Duties of the Corps Area Commanders.**—Ultimately the burden of mobilization falls upon the Corps Area Commanders of whom there are nine in the continental United States. They are in command of relatively equal segments of the country from a population viewpoint. They have many duties, amongst which are *mobilization of the manpower* of the Corps Area. This is done for the Regular Army through the Army Recruiting Service, of which each Corps Area has a branch. They put into effect orders to the Regular Army Reserve enlisted men to report for duty as the need arises. Likewise they order the various categories of Reserve Officers to duty in accord with the expansion and needs of the Army. When the National Guard of the States becomes the National Guard in the service of the United States this induction is effected by boards of officers set up by the Corps Area Commander. Mobilization or induction of the Selective Service enrollees is a function of the State Government until their Local Boards send on call groups of physically passed individuals for induction. The call comes from the Corps Area Commander, and the men are inducted into the Army by Induction Boards set up by the Corps Area Commander.

**Other Duties of the Corps Area Commander.**—Among these are the feeding, housing, clothing and preliminary training, and the classification, forwarding and assigning to proper units of the enrollees and recruits. Once these men go into a unit, unless it be a unit of the Corps Area Service Command, they pass from the control of the Corps Area Commander and are under the Army Commander. The United States is divided into four

Army Areas each of which supports a field army—thus accounting for the four field armies of our mobilization program—slightly altered into providing for the Protective Mobilization Plan and the several Augmentation Mobilization Plans. Those enrollees or recruits who find their way into the units of the combat divisions of the Regular Army or National Guard or the Armored Force or of the units found in Corps and Army supporting troops are in the *Fighting Army*. One of the wise provisions of the present mobilization program is a separation of the Task or Combat Force from the Utility Force of the Corps Area Service Command—a homely but true designation for the latter being *Housekeeping Troops*.

**The Corps Area Service Command.**—This is a large group of selected units of many categories which perform services for the combat troops and in that way permit the Corps Area Commander to accomplish his mission. The service unit is the organic means of effecting the will of the Corps Area Commander. Individuals by proper order pass from the field army units to the Corps Area Service Command, and vice versa. One may quite readily determine the location of a Corps Area Service Command from the number of the unit. Beginning with the First Corps Area the numbered units are in the 1100's, through to the Ninth Corps Area where the units are in the 1900's. The Corps Area Headquarters is always in the even hundreds, as 1100, 1200, etc. Examples of units in the Third Corps Area are:

Headquarters, Third Corps Area, Baltimore, Md.	1300th Service Unit
Reception Center, New Cumberland, Pa.	1301st Service Unit
Station Complement, Indiantown Gap Military Reservation, Indiantown Gap, Pa.	1325th Service Unit
Organized Reserves, Third Corps Area	1330th Service Unit

**Induction Boards.**—Approaching closer to the medical task are the Induction Boards, and their duties are most important to prevent the acceptance of poor mental and physical specimens, who would later become burdens on the community as wards of the Veterans Administration. An astonishing report<sup>1</sup> showed that at the date of its compilation the rejection rate of our youth was 31 per cent, which is approximately the



final figure for World War I rejections for physical imperfections.

**Station Complements.**—This type of unit found in the Corps Area Service Command is a new and important one. A Station Complement renders utility service for the troops training on the reservation in question, freeing them from the major duties of supply, transportation and hospitalization, and permitting them to spend a maximum amount of time in becoming proficient for combat. Such a Service Command unit consists of a *Headquarters*, with the camp commander and his staff and a headquarters detachment. There is a detachment of *Military Police*, the transportation is pooled and is operated by a *Motor Transport Detachment*, while many phases of supply and other utilities are under the *Quartermaster Detachment*. Hospitalization for the whole camp, both combatant troops and service troops, is performed by the *Station Hospital*. It will be necessary to return to the organization and operation of this important unit later, after pertinent Medical Department data have been briefly considered in order to give a medical background for the mobilization program.

#### MEDICAL BACKGROUND

**Hospitalization Needs.**—The civilian practitioner, who has but slight acquaintance with the Army, is always amazed at the large size of the Army hospitals, which have facilities greatly in excess of the needs of a civil community of similar size. Such an excess of beds is necessary because the patient in the Army hospital must be retained there until he has recovered to the extent that he is fit for duty. Convalescent care is not possible in barracks. Love<sup>2</sup> has made pertinent analyses of bed needs, which are used as a basis for our hospitalization program. He found that the daily admission rate for seasoned troops, allowing for seasonal variations, for nonbattle injuries and illness, when translated into hospital bed needs was 40.9 per 1000 men, or 4.09 per cent. In setting up this huge program it was decided to allow beds for 5 per cent of all troops in service—subdivided into 4 per cent beds in station hospitals and 1 per cent beds in general hospitals.

**Medical Department Expansion.**—This program has ef-

fecting an expansion of 350 per cent in hospital facilities of the Medical Department, according to Surgeon General Magee.<sup>3</sup> In actual figures, the existing general hospitals were expanded to provide for 14,000 beds—and this program is either complete or nearing completion. Existing station and camp hospital facilities have been expanded to a total of 56,000 beds. This gives a total of 70,000 beds, or a basis of 5 per cent of the 1,400,000 officers and men of the Army. There are now in the neighborhood of 200 station hospitals—of which some 100 are new cantonment type construction in their entirety. The construction program has likewise called for the building of nine cantonment type general hospitals named for famed deceased medical officers. In the proper place there will be further detailed discussion of these hospitals. Further increases in the Army in event of actual armed conflict will call for further increases of Medical Department installations. A sense of gratification must be felt by all physicians in the knowledge that the same priority was given hospital construction in the stations as was given the supply and utilities construction. Such a health-promoting policy was lacking in World War cantonment construction programs.

**Medical Personnel Requirements.—Officers.**—In time of peace the requirements for Medical Department officers is 6.5 per 1000 troops; thus it is at once apparent that, in order to officer the Medical Department installations effectively, a rapid expansion in the officer corps was demanded. It is to be remembered that the newly commissioned officers did not all receive calls to hospitals, but that Corps Area Surgeons, on the basis of available records and using their best judgment, assigned officers where they could do the greatest good and most effectively give to the Army the results of their training. There are heartaches—but not nearly so many as in 1917–18. Considering that all combat units, from a battalion upwards, require medical officers, that hospitals need them and that a limited number are on school and administrative assignments, one has an idea of the diversity of their assignments.

Based on the above figures the need for Medical Corps officers was 9100 for the first year of the training program. The Regular Army furnished some 1230 and it was anticipated that

1115 would be derived from the National Guard and the balance would be furnished by the Medical Reserve Corps. This balance numbered some 6755 officers, of whom about 1200 were on duty on September 16, 1940, when the first National Guard division was inducted.

In addition to the Doctors of Medicine there are definite ratios per 1000 troops for *Dental, Veterinary Corps, Medical Administrative and Sanitary Corps Officers*. In all categories, save the last one, the members of the Regular Army were supplemented by the National Guard and Officers' Reserve Corps. The Sanitary Corps, consisting of water and sewage and other nonmedical experts, exists only in the Officers' Reserve Corps. The total requirements of the *Army Nurse Corps* are 5600, or four per 1000 for this first year of training. The Reserve members of the Army Nurse Corps are furnished by the Red Cross which recommends names to the Surgeon General of the Army, who appoints them with the relative rank of Second Lieutenant.

*Enlisted Medical Department Personnel.*—For the first year of training this should reach a figure of 68,000. These men are very important assistants to the officers of the Medical Department in every phase of its activity, from the nursing of patients to the handling of administration. There is at present a leaven of the old-time Regular Army noncommissioned officers serving as Reserve Officers or in advanced noncommissioned ranks and in important positions in all Medical Corps installations. The younger men come to the Medical Department through the recruiting service or through the Selective Service. Those men allocated by selection may come direct or after an initial period of basic training at the large Medical Department Replacement Centers at Camp Lee, Virginia, and Camp Grant, Illinois, which provide partially trained soldiers. Then, too, certain enlisted men are received from schools and hospitals of the Medical Department where they have received specialist training as medical, surgical, x-ray, laboratory and physiotherapy technicians. These men are sent to the station hospitals, general hospitals and field units of the Medical Department. It should be added that, in all of the above installations, training of all categories of personnel is continuous and progressive.

## MEDICAL SERVICE IN PERMANENT CAMPS

Up to this point the discussion has been of general nature. Now it is necessary to come down to cases if potential doctors in these camp medical installations are to know what to expect.

**The Combat Troops.**—At a particular station these may number a division or more, or the station may be a selected one for Artillery, Signal Corps, and so on, including such institutions as the Medical Field Service School at Carlisle Barracks, Pennsylvania. Each organization upwards from a battalion through a regiment has medical personnel. These troops set up *Battalion* or *Regimental Dispensaries*. Here at "sick call," which is one of the stated early morning calls in all Army posts, are paraded the ill of the unit. Treatment is given those who are able to return to duty, while the others are taken to the *Station Hospital*. All posts have station hospitals and in the training camp or in the fixed post they are named after the post or station. In the field a different designation is given them, which is not pertinent to this discussion.

**Station Hospitals.**—This installation was mentioned in previous paragraphs which dealt in a general way with bed capacities and expansion of institutions. In the cantonment camp where so many combat units are training this hospital is a part of the Corps Area Service Command (Station Complement), but it actually is, within limits, a general hospital for that post.

**Construction.**—Buildings for such hospitals are constructed in the main of wood and are of the familiar cantonment type; some are used as wards, others as operating pavilions, and still others as supply or administration buildings. All buildings are connected by passageways, those over which patients travel being covered. These hospitals occupy large areas of ground, being widely spaced as to buildings to mitigate the fire hazard. The hospital of 1000 beds will have about seventy-five buildings and occupies some seventy-five acres of ground if it is available. The hospitals are on one side of the camp as a rule and somewhat removed from other activities.

**Personnel Needs of Station Hospitals.**—The hospital personnel needs depend on the size of the hospital. Obviously, a camp of 60,000 troops with a station hospital of 2400 beds



Fig. 186.—Airplane view of the Station Hospital, Indianatown Gap in the background. This hospital is of the type of cantonment construction found in station hospitals and the newer named general hospitals, also individual hospitals of Hospital Centers (which contain from 3 to 15 or more general hospitals) grouped about the administration buildings, and cantonment type numbered station hospitals of the Theater of Operations. (Courtesy of Major E. C. Scattergood, Air Corps, U.S.A., Commanding Officer, 103rd Observation Squadron for Aerial Photography.)

has certain requirements in excess of one of 15,000 troops with a 750-bed hospital. Table 1 gives, in brief, certain pertinent data on station hospitals and their personnel. In the 1000 bed hospital, fifty-eight of the enlisted men hold warrants as sergeants of various grades. These quoted figures are ideal ones for all classes of personnel, and are not usually attained.

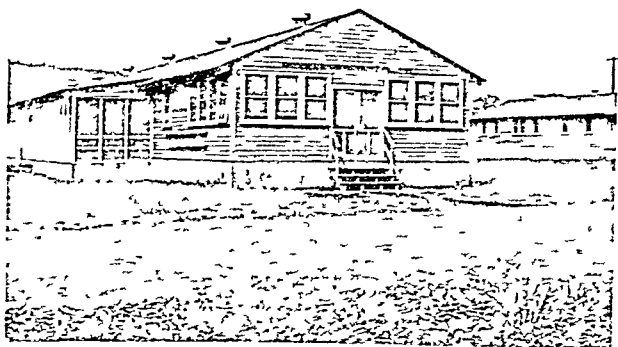
TABLE 1  
DATA ON STATION HOSPITALS AND THEIR PERSONNEL\*

Beds	Commanding Officer	Medical Corps	Dental Corps	Medical Adm. Corps	Army Nurse Corps	Chap-lains	Enlisted
25	Major MC	2	1	.	2	..	20
100	Lt. Col. MC	8	2	3	15	.	63
250	Lt. Col. MC	14	2	3	30	1	201
500	Col. MC	25	3	6	37	2	275
1000	Col. MC	46	6	6	120	3	500
2000	Col. MC	78	9	8	220	3	900

\* Obtained from Table V, MR 4-2, Changes 1, April 9, 1941.

*Administrative Service.*—The commander and his executive officer are carefully selected officers of the Regular Army, and are aided by noncommissioned officers of the Regular Army on duty as Reserve Officers, or by especially well trained Reserve Officers from the other administrative departments, such as Adjutant, Supply, Mess, Registrar and Commander of Hospital Detachment.

*Professional Services.*—In hospitals which are large enough to make it practicable there is appointed a Chief of the Medical Service and a Chief of the Surgical Service. In many of the station hospitals these officers are men who have been teachers of medicine or surgery, or are certified by their board or have other professional recognition. The assistants generally have spent considerable time on the specialty. The most junior officers are frequently recently graduated interns. The Medical and Surgical Services have subsections such as one would expect to find in a well rounded civilian institution. The chiefs of service direct and plan the service and are responsible to the commander for the professional care of patients. A list of these specialties is given in Table 2.



A



B

Fig 187—Views of Station Hospital, Indiantown Gap, Pa., showing a typical ward exterior and interior. Similar construction is found in all cantonment type hospitals, whether they are station hospitals or general hospitals, unlike evacuation hospitals, which are mobile units and utilize canvas and any available fixed structures. This is the Third Echelon of Medical Service.

B shows the interior of a typical ward. The lower portion of the walls is painted an apple green, with upper portion and ceiling a cream color. These colors are pleasing and restful to the eyes.

Similar types of structures are found in Fourth and Fifth Echelon Medical Service, whose units are from 50 to 100 miles to an unstated distance from firing line. (Courtesy of Col Frank H Dixon, MC, USA, Camp Surgeon, and Col Asa M Lehman, MC, USA, Commanding Officer, Station Hospital, Indiantown Gap Military Reservation, Pa.)

TABLE 2  
MEDICAL AND SURGICAL SPECIALTIES IN STATION HOSPITALS

1. <i>Surgical Service</i>	2. <i>Medical Service</i>	5. <i>Dispensary and Out-patient Service</i>
Anesthesia	General Medicine	Prenatal*
Orthopedics	Contagious	Pediatric*
Obstetrics and Gynecology*	Neuropsychiatry	Prophylaxis
Urology	Detention	Pharmacy
Eye, Ear, Nose, Throat	Dermatology	General Examination and Treatments
Röntgenology	3. <i>Laboratory Service</i>	
Physiotherapy	4. <i>Dental Service</i>	

\* These services may be set up in any Station Hospital, but are found in the main on the fixed stations of the Army and not in the large cantonment type hospitals.

**Classes of Patients Treated in Station Hospitals.**—Restrictions pertaining to the types of diseases treated and the classes of patients admitted are rather rigidly observed in station hospitals. All emergencies are cared for irrespective of the source, but unauthorized civilians as soon as practicable are moved to a civilian institution. Soldiers who have certain types of chronic disease are sent initially to the general hospitals. Conditions which on admission will take in excess of sixty days for cure, or those which have been *under treatment* for sixty days and still require considerably more time, are also treated in the named general hospital. The routine type of injury or infection, fracture, acute perforations of viscera, acute appendicitis, incarcerated or strangulated hernias and line of duty hernias, are some of the surgical conditions for which operation is done. On the medical side, practically all acute conditions of all tracts of the body are treated, including venereal diseases. However, patients with nervous and mental diseases or chronic medical diseases, after diagnosis is made, are sent to proper general hospitals for treatment and final disposition. This has quite logically led us to the named general hospital, and at this time the pertinent place it occupies in the medical service in the permanent camp or station will be discussed. Patients discharged from the station hospital, who, are cured, return to duty with their organizations.

**The General Hospital.**—It has already been stated that 1 per cent of beds on the basis of Army population were to be



allocated to general hospitals. These are 1000 bed institutions named after deceased officers who have contributed to the making of our Medical Department. In the present program of bed acquisition it was necessary, in order to obtain a total of 14,000 such beds, to construct nine cantonment type general hospitals to supplement the five permanent named ones: The latter institutions are, to-wit: The Walter Reed Hospital, Washington, D.C.; the Fitzsimons Hospital, Denver, Colorado; the Station Hospital, Fort Sam Houston, Texas; the Army and Navy Hospital, Hot Springs, Arkansas, and the Letterman Hospital, San Francisco, California. The newly constructed hospitals when completed will be as follows: Barnes, Vancouver Barracks, Washington; Lawson, Atlanta, Georgia; LaGarde, New Orleans, Louisiana; Hoff, Santa Barbara, California; Billings, Fort Benjamin Harrison, Indiana; Lovell, Ft. Devens, Massachusetts; Tilton, Ft. Dix, New Jersey, and the O'Reilly, Springfield, Missouri. In appearance these newly constructed hospitals are not greatly different from the station hospitals. Because of the fire hazard they, too, occupy large acreages.

*Control of General Hospitals.*—These hospitals are directly under the control of the Surgeon General, and are in reality separate Medical Department posts, differing from the station hospitals which are ultimately under the Corps Area Commander. The commander of the named general hospital is generally a Colonel, Medical Corps, infrequently a Brigadier General, Medical Corps.

*Personnel and Services of the General Hospital.*—One of these hospitals has a complement of 73 officers, 120 nurses and 500 enlisted men. It has a well balanced staff of specialists obtained from both the Regular Army and the Organized Reserve Units, and by direct commission from civil life. These physicians are divided into the many services found in our most advanced civilian institutions. Special forms of treatment, including x-ray therapy and dietetic consultation, are available. The *Medical Service* lists gastro-enterology, neuropsychiatry, general medicine, cardiovascular diseases and communicable diseases, Officers' Section, and further within these sections are found the branches of dermatology, allergy, tuberculosis and

basal metabolism, with treatment by men trained especially in these fields. The *Surgical Service* lists sections in orthopedics, urologic surgery, eye, ear, nose and throat surgery, septic surgery and general surgery. In addition, specialists thoroughly trained in thoracoplastic surgery, brain surgery and maxillo-facial surgery are found. The *Dental Service* contains oral surgeons and prosthetists as well as general dentists, although there is less divergence here from the station hospitals which furnish the same services. The usual—but exceptionally well equipped—x-ray and laboratory and other services are available.

One may have noted in the early paragraphs of this section that the general hospitals are allocated in such a way that they can best serve the large concentrations of troops. For instance the Tilton Hospital at Fort Dix, New Jersey, is to receive patients from the Second and Third Corps Area installations, which are, in the main, station hospitals.

The patients discharged from the general hospital, if fit for duty, return to their commands, while the individuals for whom effective rehabilitation cannot be accomplished are discharged from the hospital and cared for in a variety of ways not pertinent to this discussion.

In these hospitals of general and station type the officers of the Medical Department have the important yet diametrically opposed duties of *conserving the fighting strength of the army*, and of *being a watchdog to prevent abuses of the privileges of the Veterans Administration*.

#### MEDICAL SERVICE IN THE FIELD

It is in the field—whether in maneuvers or in combat—that the *conservation of the fighting strength* of the Army puts the Medical Department on its mettle. Before giving details connected with this duty, with some discussion of the organization and operation of the units involved, the presentation of pertinent facts pertaining to the combatant forces is essential.

**The Field Army.**—It will be recalled that the United States is divided into nine Corps Areas for administrative purposes. Each of these Corps Areas furnishes, when called to do so, certain combatant divisions and supporting combat and

service troops. The allocation of divisions is as follows: (1) Regular Army, (2) National Guard and (3) Organized Reserves—all infantry divisions. The Regular divisions are numbered from 1 to 25, but only nine have to date been organized. The National Guard divisions number from 26 to 75 of which numbers 26 to 45 inclusive (less No. 42) are in the service of the United States, the remainder not being organized. The Organized Reserve divisions number from 76 to 103, and are "square divisions," as also are those from the National Guard. None of the Reserve divisions has been activated.

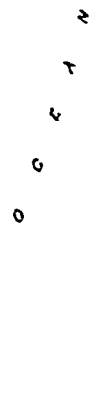
*"Square Divisions" Contrasted to "Triangular Divisions."*—These terms are often confusing, and a brief word to clarify them may be in order. A *triangular division* is one which has three infantry regiments, with the elimination of brigades as organic elements and the substitution, save in the case of the Artillery, of battalions of engineer, quartermaster and medical troops; it numbers some 15,000 officers and men. The *square division*, which numbers slightly in excess of 21,000 officers and men, contains four infantry regiments divided into two brigades, and is backed up by regiments of quartermaster, engineer and medical troops, and a field artillery brigade of three regiments.

*The Armored Division.*—This unit is our answer to the German "Panzer" division. There are four of these organized at this time. They are "triangular" in that each has three Tank regiments with a personnel of about 12,000 men and in excess of 400 tanks.

*Allocation of Field Armies.*—The United States is divided into four Army Areas, to wit: FIRST ARMY, First, Second and Third Corps Areas; SECOND ARMY, Fifth and Sixth Corps Areas; THIRD ARMY, Fourth and Eighth Corps Areas; and FOURTH ARMY, Seventh and Ninth Corps Areas. (See chart of Corps Areas and Army Areas, Fig. 188.) In our Army there is what is known as the *Type Army Corps* which consists of three Infantry divisions and supporting Corps troops, while the *Field Army* consists of three Corps plus Army troops. The former may number 85,000, while the latter may number 350,000.

Each unit in the Field Army, above the size of a company, has its own medical troops. They are allocated in number

**NAME**



## 1

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according to the strength of the parent organization, and are themselves organized to serve most efficiently the unit to which they are attached.

**Medical Service in the Field—Not Combat.**—Troops living under field conditions and not in contact with the enemy will care for their sick and wounded in much the same manner as in the camp or permanent station. Ill and injured will be first seen in unit dispensaries and those requiring hospitalization will be transported to station hospitals which, if in the Combat Zone or in the immediately adjacent Communications Zone, will be numbered hospitals. The combat troops may be directed to send their cases to an *Evacuation Hospital*. This installation will be shortly taken up.

**Medical Service in the Field during Combat.**—When the troops move out of the training area into the Combat Zone where contact with the enemy becomes their mission a different *Evacuation Chain* comes into play and certain medical contingents which until now have been undergoing training assume their real functions.

**THE ECHELONS OF FIELD MEDICAL SERVICE.**—A better understanding of the phases of evacuation may be found in a presentation of the *Echelons of Field Medical Service*:

1. *First Echelon.*—This service is provided in every command larger than a company by the attached medical personnel of the battalion or larger unit. The Medical Department installation is the *BATTALION AID STATION*, or *DISPENSARY*. (800 yards.)

2. *Second Echelon.*—This provides for the collection of ill and injured from the battalion aid stations and dispensaries and their concentration in *CLEARING STATIONS* by medical units of the division, corps or field army. (5 to 7 miles.)

3. *Third Echelon.*—This service provides the evacuation of casualties from the clearing stations to places of hospitalization—*EVACUATION HOSPITALS*—which are part of the Army Medical Service. (15 to 30 miles.)

4. *Fourth Echelon.*—This service provides removal of patients from the evacuation hospital to the *GENERAL HOSPITALS* by Theater of Operations Medical Service. (50 to 100 miles.)

5. *Fifth Echelon.*—If further evacuation of casualties is necessary they are sent to the Zone of the Interior by direction of General Headquarters.

This outline indicates the stages of withdrawal from a *stabilized front*, and in parentheses are the normal distances of the particular installations from the front lines. It is highly improbable that the conditions presented by a stabilized front





Fig. 190.



Fig. 191.

Figs. 190 and 191.—Views of a Collecting Station set up by personnel of a Collecting Company, 1st Battalion of a Medical Regiment, at a distance of 1500 to 2000 yards from the firing line. This is a part of the Second Echelon of Medical Service. (Courtesy of 1st Lieut. Robert M. Olson, M.C., U.S.A., Station Hospital, Indiantown Gap, Pa., and Col. C. S. Hendricks, M.C., U.S.A., Division Surgeon, 28th Division and Commander of the 103rd Medical Regiment.)



will exist for us again in case of war, if one is to judge from the tactics of World War II. Certainly the staid, slow methods of 1918 will be no more effective in an evacuation of a field of battle today than would be the combat methods of 1918 in the defeat of the 1941 enemy. Speed of movement of troops has placed a great burden upon the evacuation system now being taught. It must be said in all fairness that, with his present knowledge of medical tactics, the medical officer will without doubt be able to adapt himself readily to the changed



Fig. 189.—Battalion Aid Station set up by troops of the Battalion Medical Section of the Medical Detachment of the Combat Regiment. It is placed about 800 yards to the rear of the firing line, and is the First Echelon of Medical Service. (Courtesy of 1st Lieut. Robert M. Olson, M.C., U.S.A., Station Hospital, Indiantown Gap, Pa., and Col. C. S. Hendricks, M.C., U.S.A., Division Surgeon, 28th Division and Commander of the 103rd Medical Regiment.)

requirements of modern warfare. This will be so whether it requires trucks, airplanes or ambulance units to move the wounded.

*"Time Lag,"* from the wounding of the man to the time when he comes under definitive treatment, has never been of more importance than today, for if the slightly wounded may be treated before the organisms have "dug in," then proper wound treatment plus chemotherapy will quickly restore the man as an effective. It was the late Marshal Foch who stated

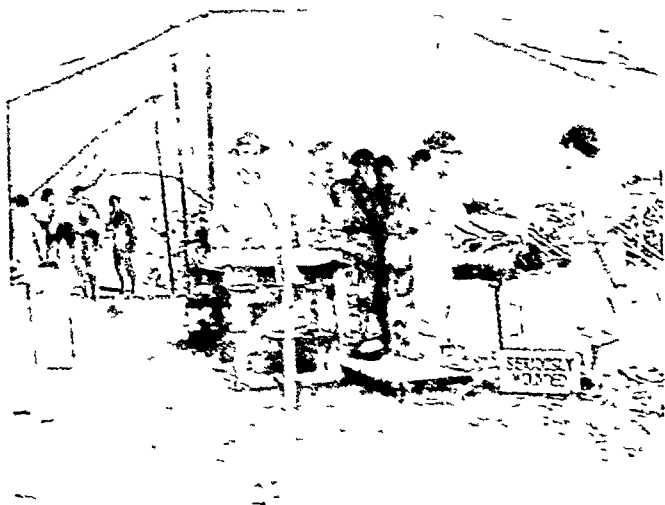


Fig. 192.



Fig. 193.

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that the winning of a war was dependent upon the rapidity with which the "petit blesses" (slightly wounded) are returned to their organizations. Today's total war with fast-moving armies—and especially the disruptive mechanized forces—will greatly strain our Medical Service, and will cause many "old tried and true methods" to be discarded, though in all probability no new principles will be born.

**The Medical Detachment of a Regiment.**—This unit, its size depending upon the organization, is in reality a medical company, for it conducts its own internal administration. It furnishes medical service to the parent unit either through a *Dispensary* or through the establishment of *Aid Stations*. Personnel from this detachment perform First Echelon services by giving first aid to the wounded on the field and effecting a clearing of their regimental area of casualties. The station gives first aid and prepares patients for transportation to the rear by the Second Echelon. These detachments are usually commanded by a Major, Medical Corps, and consist of from ten officers and 96 enlisted men in an Infantry regiment to as few as a detachment of one officer and nine enlisted men with the Artillery Ammunition Train.

**The Medical Regiment or Battalion of a Division.**—The "square division" has a *Medical Regiment* of three battalions. The first battalion of three companies collects by litter and establishes a collecting station; the second battalion, composed of three ambulance companies, provides for transportation of the wounded; the third is a clearing battalion of three companies each of which may set up a clearing station, formerly called a field hospital.

The cavalry division, motorized division, armored division, and the triangular infantry division each has the services of a *Medical Battalion* for the collection of injured, their transportation to the rear and preliminary hospitalization, and final clearing to the rear. This battalion varies in size depending on the division to which it is attached, but the functions of all are the same. This constitutes *Second Echelon Evacuation*, and provides more satisfactory first aid than can be given in the regiments. It undertakes emergency life-saving procedures, treats shock, and *sorts* the wounded.



Fig. 192.



Fig. 193.

Figs. 192 and 193.—Views of a Collecting Station set up by personnel of a Collecting Company, 1st Battalion of a Medical Regiment at a distance of 1500 to 2000 yards from the Spring Line. This is a part of the Second Echelon of Medical Service. (Courtesy of 1st Lieut. Robert M. Olson, M.C., U.S.A., Station Hospital, Indiantown Gap, Pa. and Col. C. S. Handrick, M.C., U.S.A., Division Surgeon, 15th Division and Commander of the 103rd Medical Regiment.)

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It is alongside these divisional medical installations that, when great need for emergency surgical operations becomes apparent, the Army Surgeon sends a *Surgical Hospital* to assist. It has a capacity of 400 patients, has 50 officers, 60 nurses and 275 enlisted men. It has a mobile section which with its personnel and transportation facilities may set up a temporary surgical unit of four operating rooms. If reinforced by surgical teams it has sufficient equipment and supplies to permit eighty major surgical procedures each twenty-four hours. It has two hospitalization units each of which accommodates 200 patients. This hospital may operate, in stabilized warfare, from 4 to 7 miles from the lines. There are four of them available to the Army Surgeon.

**The Evacuation Hospital.**—This is the normal installation for hospitalization of the *Third Echelon*—it is an Army medical service unit, and there are ten of them for each field army. They may utilize buildings or tentage and when possible should be moved by rail. They receive their patients from clearing stations by truck or ambulance, but they usually evacuate to the rear by rail. The complement is 47 officers, 52 nurses and 318 enlisted men.

Many of these units at present—as with the surgical hospitals—are purely paper organizations to be activated some weeks or months prior to their actual need by the combatant troops. In a goodly number of instances these units have been, at the invitation of the Surgeon General of the Army, formed about the staffs of well known civilian institutions, and the places on the professional services filled by competent specialists, and in proper rank. Such an institution is an *Affiliated Unit*. It will be activated only for war service, and the officers commissioned therein void their appointments if and when they sever connection with the institution. An example of such a unit is the 52nd Evacuation Hospital, affiliated with the Pennsylvania Hospital, Philadelphia, Pa. An example of an activated paper unit is Evacuation Hospital No. 15, which is at Fort

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is located 5 to 7 miles from the front. (Courtesy of 1st Lieut. Robert M. Olson, M.C., U.S.A., Station Hospital, Indiantown Gap, Pa., and Col. C. S. Hendricks, M.C., U.S.A., Division Surgeon, 28th Division and Commander of 103rd Medical Regiment.)



Fig 194

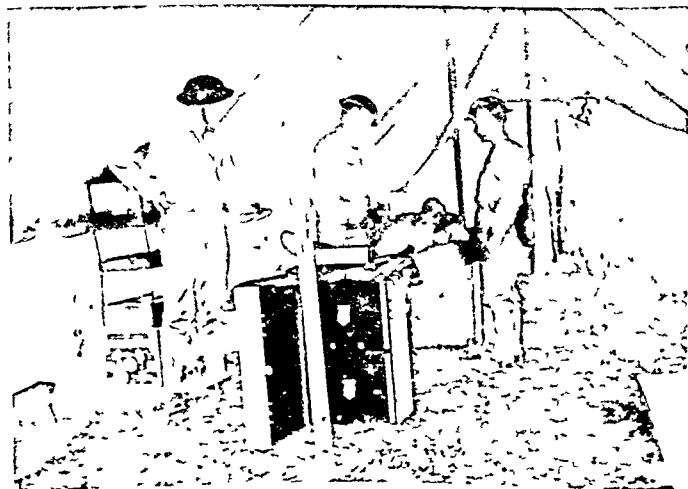


Fig 195

Figs 194 and 195—Clearing Station Set up by one or more companies of the Clearing Battalion, 3rd Battalion of a Medical Regiment, or of a Clearing Company of a Medical Battalion. Figure 194 shows a Clearing Company, 103rd Medical Regiment, at station in a woods camouflaged against air observation. Capacity of this station is normally 250 to 750 patients. It is the concentration point for patients of the Second Echelon of Medical Service and

ibly be done in an evacuation hospital because early movement postoperatively might impair the result or jeopardize life, are brought into this *Fourth Echelon Medical Service*. They are transported by a mobile unit, the *Hospital Train*, which may be of standard hospital cars of various types including a ward and an operating car, or of improvised type which meets the requirements as closely as possible. This train is under the Chief Surgeon of the Army. It is manned professionally by a group of Medical Department officers, nurses and enlisted men, but is operated by the Corps of Engineers. The patients moved by this means are taken to the *fixed hospitals* in an area removed from combat, either in the Communications Zone or farther away in the Zone of the Interior. These hospitals are *general hospitals* and are in every respect similar to the named general hospitals referred to in the discussion of permanent camps. There is again a disproportion of wounded men in such hospitals, adjacent as they are to the combat area. Another source of patients for these hospitals is the *numbered station hospitals* of the Communications Zone or Zone of the Interior which serve concentrations of service troops. They are organized and operate in every respect as do the station hospitals of the station complement of camps. Here the proportion of ill and injured is more nearly that of the training area station hospital.

**The Hospital Center.**—It is proposed to follow the practice of World War I in grouping general hospitals of 1000 beds about a central administrative group to mitigate the problems of administration, utilities and supply. Three such hospitals with a convalescent camp could accommodate normally 4000 beds, with possible expansion to 8000, while such a center with ten general hospitals would have an expansion capacity to 22,000 patients. The Hospital Center is the normal command of a Brigadier General of the Medical Department. It is the only installation in the Army where the medical officer commands troops of the Arms or Services, for there are to be assigned to such a center Quartermaster Corps units, Military Police units, Signal Corps Detachment, Finance Department Detachment and a Postal Section. In addition to the regular administrative personnel there is assigned to the Center Com-



George G. Meade, Md. The officer personnel, both professional and administrative, are ordered to duty in grade and number according to Tables of Organization. In the Combat Zone the duties of each hospital will be identical, although their origins differ.

An evacuation hospital is a semimobile hospital which under the old conditions of static warfare was, except for the occasional cases sent to the surgical hospital (Mobile Surgical Unit), the first haven where definitive surgical treatment could be given, and where those wounded who would stand transportation well could, after more preparation, be sorted out for movement further to the rear. This institution has, however, a well balanced surgical staff numbering amongst its members specialists in plastic and maxillofacial surgery, neurosurgery, thoracic surgery, shock teams and splint teams, in addition to the general surgical teams. There is an adequate x-ray and laboratory service to serve both the disproportionately large surgical service and the smaller medical service. This apparent imbalance is of course due to the fact that many more injured than sick patients are treated by this hospital. The unit is self-sufficient in all departments. Patients either are discharged from this hospital to the convalescent hospital, where after complete recovery they are sent to the Replacement Center for reclassification and assignment, or they are shipped by hospital train to a general hospital far removed from the combat area.

The *Convalescent Hospital*, which with the evacuation hospital constitutes the installations of greatest importance to actual treatment of patients in the Third Echelon of Medical Service, has a capacity of 3000 patients and a professional staff of sufficient but small size, and is allocated one per Army Medical Service. Like the evacuation hospital and the surgical hospital, it is under direction of the Army Surgeon, who is the senior medical officer on the staff of the field army commander.

**The Hospital Train—General Hospitals.**—Patients who need a longer recovery period than can be provided by the convalescent hospital, or who perhaps need a series of operations, or who initially need an operation which could not feas-

ment, many of whose units hark back to World War I in organization and operation. In a general way they would even now be satisfactory if they were to participate in static warfare. But little was mentioned as to tactical employment, particularly of the mobile units with division, corps and armies, because the method of their employment in modern war is difficult to foretell. The lack of a true front, the speed of maneuver and the great distances will make mandatory many alterations of medical tactics to effect the mission of the medical unit concerned. The different types of campaign will call for different management of medical service, as has been so graphically shown in the bewildering types of action of the German Army. Suffice it to say that the medical installations mentioned will be made so flexible that if war comes, our Corps will perform in the same exemplary manner it did twenty-four years ago.

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5. *Mobile Units of the Medical Department*, January, 1940, Medical Field Service School, Carlisle Barracks, Pa.
6. *Tables of Organization*, Medical Department, March, 1940, Medical Field Service School, Carlisle Barracks, Pa.

manders' Staff a corps of consultants in medical specialties for the center and its component hospitals.

One should not leave this final section without mention of the *Affiliated Units* again. As with the evacuation hospitals, so with general hospitals was an invitation extended by the Surgeon General of the Army to medical schools and hospitals to participate in the program. Many of these general hospitals arise from the same institutions which furnished the base hospital of the World War I. Where possible for morale purposes the same designating number has been again assigned, viz., General Hospital No. 10, Northwestern University Medical School and General Hospital No. 20, the University of Pennsylvania Hospital. Others could be mentioned but these examples suffice. The remaining needed general hospitals will be activated from those provided on paper in the Tables of Organization, and from personnel from all sources available to Corps Area Commanders.

Patients discharged from the *Fourth Echelon Medical Service* may be returned to duty through the Replacement Center, or if unfit discharged from the Army, or if needful of further treatment sent to the *Fifth Echelon Medical Service*. The soldier who after discharge still needs treatment usually becomes a ward of the Veterans Administration.

#### COMMENT

There has been presented a brief discussion of the present program of peacetime training, together with data gleaned from a number of sources upon the purely military side of the program. It should be pointed out that a revision upward of all phases of the program will become a necessity in event the National Emergency declared on May 27, 1941, becomes a state of war. The responsibilities of all military and civilian agencies will become at once heavier.

In speaking of combat units and combat areas, we of necessity had to deal in the terminology of World War I, but it should be stated here and now that while many units and terms are those of the World War I, these will be refashioned to meet present-day needs rapidly and efficiently.

As with the combat elements so with the Medical Depart-

## TUBERCULOSIS AND MILITARY MEDICINE

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FORMERLY SURGEON GENERAL, UNITED STATES ARMY

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### THE SIGNIFICANCE OF TUBERCULOSIS IN THE ARMED FORCES

PULMONARY tuberculosis in the armed forces is to be considered from the standpoint of the military service rather than the man and as an epidemiological problem as distinguished from a clinical entity. It is a communicable disease, especially prevalent in early military age and one to be eliminated by rejection during recruiting procedures or by discharge when encountered in a military unit.

The vicissitudes of military service in active campaign, by lowering body resistance, favor the extension of incipient tuberculosis and the breakdown of arrested cases. Its insidious approach lowers our guard and favors its spread in the Army and Navy as elsewhere. Overcrowding is often a military necessity. Close association of men in barracks, tents, billets, mess halls and recreation rooms favors the spread of tuberculosis as of other respiratory diseases. A man with active, open pulmonary tuberculosis, mingling with comrades under such conditions, is a positive danger.

Tuberculosis has impaired military power and drained the financial resources of this country out of all proportion to the number of cases. While the admission rate for tuberculosis in the Army is relatively low, it stands high among the causes of time lost. The economic importance of tuberculosis in the military establishment is enormous. Being a chronic disease it usually requires prolonged hospitalization and invalidism. Every soldier or sailor found to have tuberculosis, regardless of the circumstances of its development, will be a veteran who by congressional acts will be entitled to hospitalization and



concrete and hollow tile construction of a capacity of 1500 beds. This was the forerunner of Fitzsimons General Hospital which shortly after the World War became the center for treatment of tuberculosis in the Army, replacing Fort Bayard which was transferred to the Veterans Bureau. The Fitzsimons General Hospital was constructed on the pavilion type, adopted during the Revolutionary War to prevent cross-infection and which characterized hospital architecture for a hundred years. The pavilion wards of this hospital, two stories in height, were separated one from another by an "air space" of 150 feet. A straight line distance through the main wards and buildings of this hospital was about five miles in length. Heliotherapy was featured in this hospital, especially for non-pulmonary tuberculosis, during the years immediately following the World War. The new Fitzsimons General Hospital recently built on the site of the old one at a cost of four million dollars is a modern hospital consisting of a central building of six or seven stories for the clinics, the surgical service, wards and porches for bed patients with a number of the old pavilions being retained for ambulant cases. Its capacity is about 1200 beds with considerable facilities for crisis expansion.

The policy of the Navy in time of peace is to admit enlisted men with tuberculosis to all Naval hospitals but to concentrate them in at least one major hospital on the East coast, the Naval Hospital at Norfolk, and on the West coast the Naval Hospital at San Diego.

Prior to the World War it was the custom to discharge from the service patients with tuberculosis and other chronic diseases after a comparatively short period of treatment when it had been clearly demonstrated that they would no longer be of value to the military service. Old soldiers nearing their retirement were retained in service under treatment. Cadets of the Military Academy and officers were hospitalized until the disease was arrested or the prospects of return to duty in a reasonable time were determined as unlikely, in which case they were discharged or retired.

The average length of time during which enlisted men of the Navy are held under observation and treatment is six months.

other benefits which in the case of the last World War have cost this nation nearly a billion dollars. Tuberculosis has contributed substantially to the after-costs of our wars in terms of veterans' benefits which have totaled about fourteen billion dollars.

#### TUBERCULOSIS IN THE MILITARY ESTABLISHMENT IN PEACE-TIME

**Recruiting—Physical Examination.**—During most of the period before the World War, enlistment was completed at the recruiting stations in cities and towns, the physical examination being made by medical officers, contract surgeons or civilian physicians. For a short period after the Spanish American War, Recruit Depots and Recruit Depot Posts were established for the reception and training of "applicants for enlistment" who had been procured at the recruiting stations after a casual examination. Here the recruits were held for basic military training for several months which provided a more adequate opportunity for careful physical examination and observation. Many cases of pulmonary tuberculosis overlooked in a single examination were thereby discovered. Largely because of the expense and delay in meeting military requirements, especially along the Mexican border and our overseas garrisons, this plan was abandoned after a few years and the old order restored. The x-ray had begun to be used for clinical diagnosis and for recruit examinations at permanent military posts some years before the World War.

**Hospitalization and Disposition.**—Patients with tuberculosis which was detected at the daily sick call or monthly physical examinations were placed in the Post Hospital until they could be transferred to a general hospital or discharged from the service. Before the World War the General Hospital at Fort Bayard, New Mexico, was the only institution in the Army devoted exclusively to the treatment of tuberculosis. It had a capacity of about 400 beds. During the World War Fort Bayard was enlarged to a capacity of 1500 beds by erection of temporary wards, and other hospitals and sanatoria were established throughout the country to the total bed capacity of 6650. Among these hospitals was one at Denver, Colorado, of

Figure 197 shows the general fall in the admission rate since 1920 and the effect of the residual World War military population as late as 1921.

The *days lost* from tuberculosis, however, indicate far better than the number of admissions the real importance of this disease from a military standpoint. Tuberculosis has been fre-

RATE

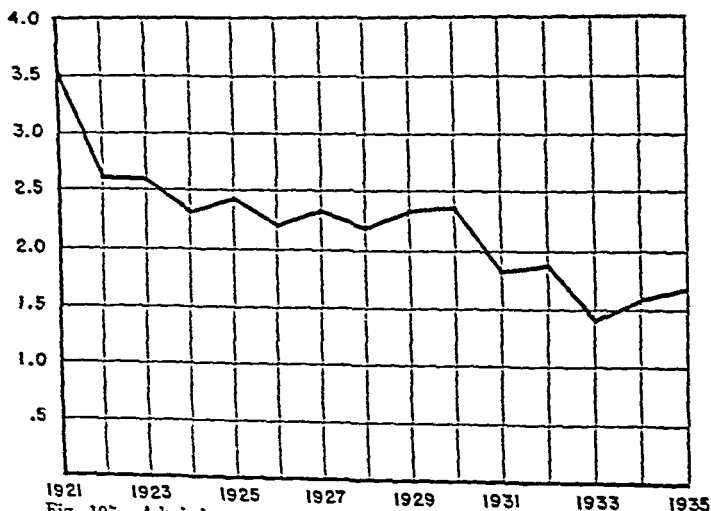


Fig. 197.—Admissions to sick report from tuberculosis, annual rates per 1000 strength, white enlisted men in the United States, 1921-35. (From Annual Report of Surgeon General, U. S. Army, 1936.)

quently as high as second as a cause of noneffectiveness, and never lower than fifth. It has been exceeded only by gonorrhea, athletic accidents, acute nasopharyngeal infections and motor accidents.

#### OUR KNOWLEDGE OF TUBERCULOSIS IN 1917 AND 1941

**Pathogenesis.—Immunity Conferred by Early Tuberculous Infection.**—In 1917 our conception of pulmonary tuberculosis in an adult was that it represented a reactivation or extension of an infectious process acquired in early life and from which recovery had taken place; that the primary infection which was quite universal supplied a measure of resistance or immunity sufficient under usual circumstances to protect from



In 1919 and for some time thereafter, in consequence of legislation affecting veterans, cases of tuberculosis were retained in military hospitals until the maximum degree of improvement had occurred. In many other instances the patients were discharged and transferred to the veterans' hospitals.

**Statistics.**—*Admission rates* for tuberculosis in military service are determined decidedly by the recruit population and the section of the country supplying the recruits. As the majority of cases of tuberculosis are discovered during the first enlistment period and particularly during the first year of serv-

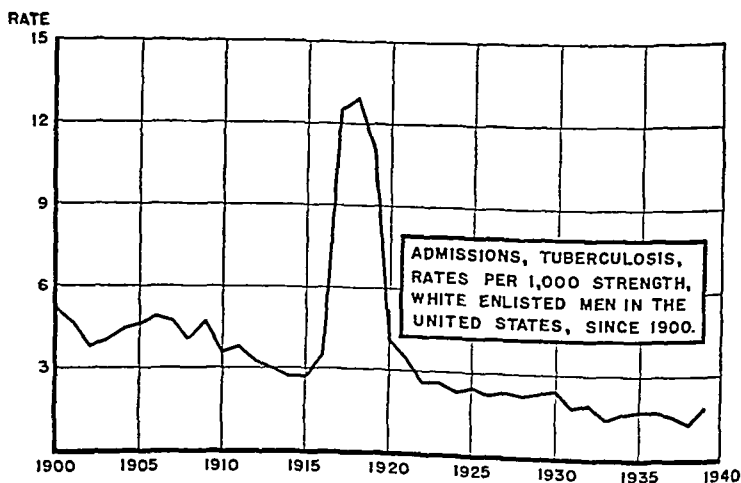


Fig. 196.—(From Annual Report of Surgeon General, U. S. Army, 1940.)

ice, waves of recruiting activity in consequence of foreign service requirements and other military activities have always caused a rise in the admission and discharge rates. In general, however, admissions for tuberculosis in the Army have fallen in the past forty years from an annual rate of nearly 5 to less than 2 per 1000 officers and enlisted men. The greatest fall has occurred since 1920, which parallels somewhat the morbidity rate for this disease in the general population.

The admission rates for tuberculosis among white enlisted men in the Army since 1900 and particularly the effect of recruiting during the World War I period are shown in Fig. 196.

infected with tuberculosis can be reinfected from without, if at all, only by large amounts of tuberculosis virus. If thus capable of exogenous infection he is likewise subject to endogenous infection, or will be unable to prevent the extension of already existing, but perhaps latent, tuberculous processes within the body. Exogenous infection in civilized man is not, therefore, of importance; nevertheless, on account chiefly of unprotected children, every care should be taken to destroy the poisons of tuberculosis."<sup>1</sup>

The bearing of this theory or conception of the pathogenesis of pulmonary tuberculosis on epidemiological control procedures can be seen as of fundamental importance.

*Present-day Hypothesis; the Exogenous Theory.*—Today we have some, but less, faith in the immunity conferred by early tuberculous infection than in 1917. We believe that clinical pulmonary tuberculosis is usually the result of contact infection. We believe in the endogenous "origin" to the extent that reinfection of lung tissue does occur from the breakdown of a primary focus and spreads through continuity, through the lymphatics or blood stream or through the bronchial pathways, but that this is not the usual course of events in the development of reinfection tuberculosis. The prevailing conception of secondary, adult or reinfection tuberculosis is that it is usually a reinfection from without, the tubercle bacilli entering the body from the outside; that it is, in other words, of exogenous origin and that the immediate source of reinfection is the active, open or positive-sputum case of pulmonary tuberculosis.

Epidemiological studies and practical experience in public health administration present a convincing array of evidence to support this idea. The character and distribution of secondary or reinfection lesions as disclosed by the x-ray tend to corroborate the belief that such infection is new, extraneous and comes from without. Upon this hypothesis have been based our conception of the epidemiology of tuberculosis and the present-day procedures for its control. Segregating the open case, tracing the source of infection in each case, examining the intimate contacts and keeping them under observation, case-finding through well conceived surveys of adult groups

further manifestations of the disease. Great faith was placed in the immunity conferred by primary infection. Colonel George E. Bushnell, the Army's foremost authority on tuberculosis and who as Chief of the Tuberculosis Section of the Division of Internal Medicine in the Surgeon General's Office shaped the policy of tuberculosis control during the World War, in commenting on the ravages of tuberculosis in Mexicans from the remote districts when employed as laborers on a railway in the Southwest, expressed this principle of immunity as follows: "Here, according to well known epidemiological laws, we have an illustration of what befalls individuals not all of whom have received the more efficient immunization against tuberculosis afforded by a life in a civilized country; the men fall sick from tuberculosis not because the environment from which they come has too much but because it has in a sense too little tuberculous infection! In other words, the tuberculosis is acute because it attacks the nonimmunized or improperly immunized individual."<sup>1</sup> The same reasoning has been used concerning the spread of tuberculosis among North American Indians when brought under the influence of "civilization" and might be used on the same hypothesis to explain the increased prevalence of the disease among the American Negroes following their migration after the days of slavery.

*Reactivation of Primary Lesion; The Endogenous Theory.*—As a logical deduction it was held that tuberculosis among soldiers in general, occurring as it does during the early enlistments, was the result of a breakdown or reactivation of a primary lesion. This conclusion was expressed as follows after the experience of the World War: "In the opinion of the medical officers most conversant with the facts, the number of soldiers who had incurred manifest disease (tuberculosis) as a result of military service was to the number of those who brought the disease with them into the Army approximately as 1 to 10. In reality it is probably considerably less than 1 to 10."<sup>1</sup>

This, then, was the "modern" view of the pathogenesis of adult tuberculosis in 1917, the endogenous theory, which had supplanted the simple theory of the immediate or more direct transmission of the disease from person to person. It was summed up as late as 1919 as follows: "An individual already

lation the rate will be only slightly over 40. This trend of tuberculosis mortality in the United States is shown in Fig. 198.

*Age, Race and Sex Incidence.*—Figure 199 shows the mortality by age, sex and race. Particular attention is drawn to the fact that the mortality rate begins to rise in early adult life and that, among white males, tuberculosis is becoming more and more a disease of old age. Even so, it is responsible for more deaths between the ages of twenty and forty years than any other disease, and about 16 per cent of all deaths between

### TREND OF TUBERCULOSIS MORTALITY DEATH-REGISTRATION AREA, UNITED STATES

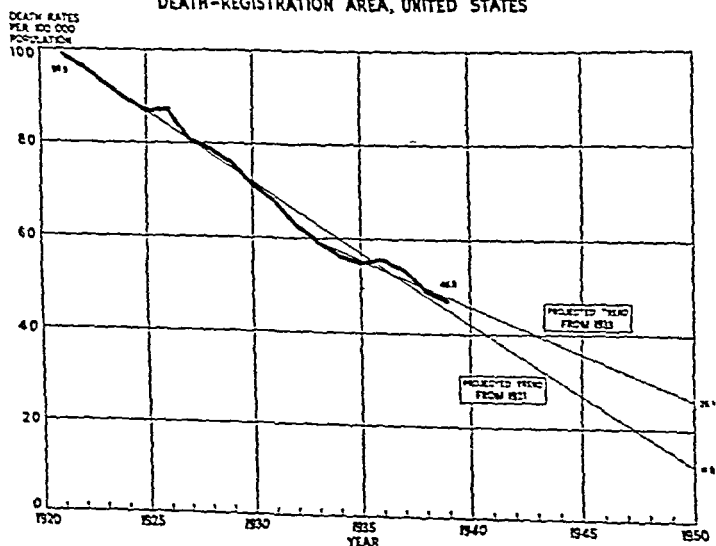


Fig. 198.—(From Dublin, Louis I.: Decline in Tuberculosis. American Review of Tuberculosis, February, 1941.)

the ages of twenty-one and thirty-six years are attributable to tuberculosis. The Negro race still has a high rate for tuberculosis. It is now about where the rate for the white population was in 1910. In 1938 the death rate among Negroes was 135 compared with a rate of 39 for white persons. Throughout the United States the rate for Negroes will be found to be between three and four times that for the white race. In some city populations the rate is as much as eight times that of white persons and it frequently occurs that a Negro population

having high incidence rates, especially the colored race, are the features of the antituberculosis campaign in the United States which is responsible for the reduction of tuberculosis during the past twenty years to a point where the end seems in sight.

**Prevalence.—Mortality Rates.**—Mortality statistics in the registration area of the United States are more accurate than the morbidity statistics. Although pulmonary tuberculosis is a reportable disease in most states, the number of cases reported is probably not more than 12 per cent of those actually suffering from this disease. In many localities the number of cases reported just about equals the number of deaths from this disease.

The prevalence of tuberculosis at the time the United States entered the World War is reflected by the statistics for the

TABLE 1

ANNUAL MORTALITY RATES PER 100,000 POPULATION, U. S. REGISTRATION AREA

Year	Tuberculosis, All Forms	Tuberculosis, Pulmonary
1916.....	141 6	123.8
1917.....	146 3	128.7
1920.....	114 2	100 8
1921.....	91 4	87.6
1938.....	48 9	44.6
1939.....	47 2	43.2

calendar year of 1916 rather than 1917 when the result of mobilization examinations began to appear in the figures. For our calculation of the situation in 1940 we must take the statistics of the year 1939. Table 1 shows the annual mortality rates per 100,000 of population for the years considered most important from a military standpoint since 1916.

The rise in 1917 can be attributed largely to case finding, the result of mobilization examinations. It will be seen that a decided fall in the rate has taken place since 1920. The rate for tuberculosis of all forms for 1940 is estimated at 45 which will represent a decline of 37 per cent in the last ten years and 61 per cent in the last twenty years. Estimates based on the same factors indicate that among 57,000,000 of the rural popu-

**Classification.**—A recognized and accepted classification of pulmonary tuberculosis is of the utmost importance, particularly right now in the military service. Without a standard, confusion will result to the prejudice of enrollees and taxpayers and detriment to our military plans. The National Tuberculosis Association first published its "Diagnostic Standards and Classifications of Tuberculosis" in 1917. Revisions have been published at intervals of from two to four years, the 1940 edition being current. It is considered a statement of principles and a

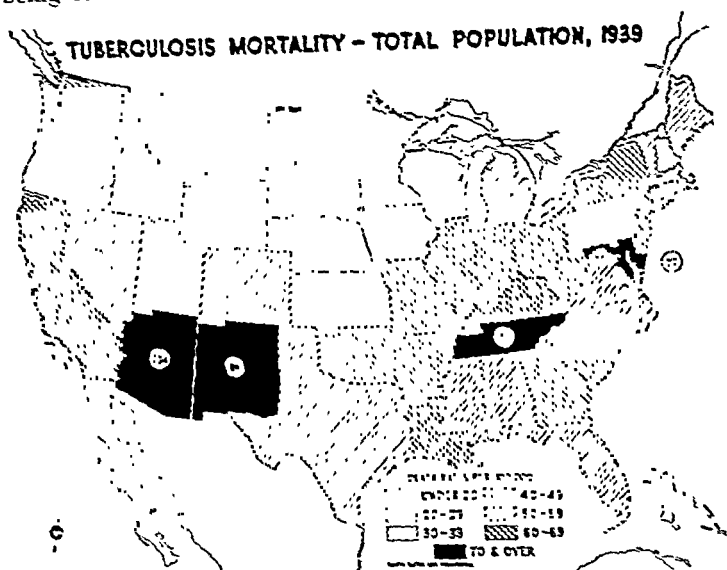


Fig. 100.—(From Dublin, Louis I.: *Decline in Tuberculosis*. American Review of Tuberculosis, February, 1941.)

general guide and, as stated in this pamphlet, "perhaps it will serve best to promote common understanding on the basis of familiar terminology and conceptions." This publication is now generally considered the standard for these purposes.

**Definitions.**—The terms "primary phase" and "reinfection phase" now replace the terms "childhood type" and "adult type," respectively. These changes have been made because the primary phase of tuberculosis, while more frequent in children, and therefore previously known as the childhood type,

of 5 per cent of the total is responsible for 25 per cent or more of the cases of tuberculosis in that community. Figure 200 shows the territorial distribution of tuberculosis throughout the United States, indicating today, as in 1917, the highest rates in the Southwest.

*The Prospect Today.*—Under the Selective Service Act of 1940 we will be taking into the military service men of the age group most susceptible to reinfection and the ravages of active pulmonary tuberculosis. Since the age limit was reduced

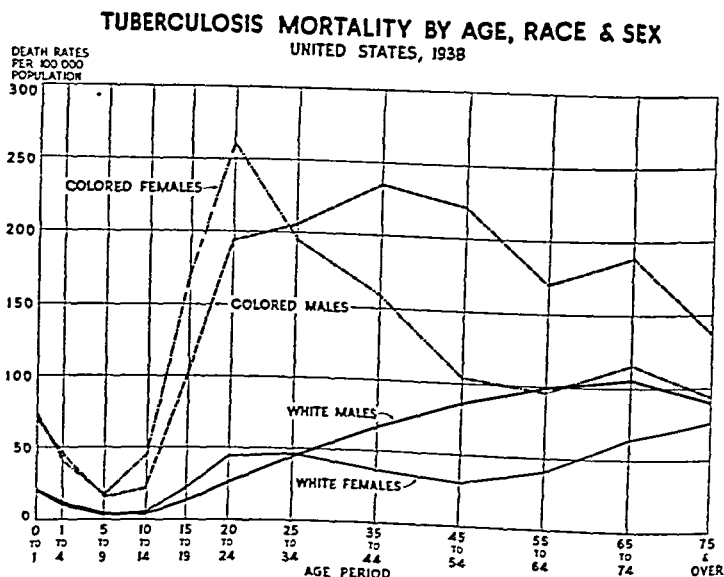


Fig 199—(From Dublin, Louis I. Decline in Tuberculosis, American Review of Tuberculosis, February, 1941)

to twenty-eight years (July 1, 1941), selection will be made from men in an even more critical span of life, the period when the infiltration process due to reinfection is beginning rather than healing, or if healed or inactive it surely will have been so but a short period of time. Modern conception of the pathogenesis of pulmonary tuberculosis is leaning toward the conclusion that reinfection occurs to a preponderant degree before the age of thirty years, notwithstanding the higher mortality rates in the higher ages.

The following classification as to extent of pulmonary lesions, severity of symptoms and clinical status is quoted from the same source:

### EXTENT OF PULMONARY LESIONS

#### *Minimal*

Slight lesions without demonstrable excavation confined to a small part of one or both lungs. The total extent of the lesions, regardless of distribution, shall not exceed the equivalent of the volume of lung tissue which lies above the second chondrosternal junction and the spine of the fourth or body of the fifth thoracic vertebra on one side.

#### *Moderately Advanced*

One or both lungs may be involved, but the total extent of the lesions shall not exceed the following limits:

Slight disseminated lesions which may extend through not more than the volume of one lung, or the equivalent of this in both lungs.

Dense and confluent lesions which may extend through not more than the equivalent of one-third the volume of one lung.

Any gradation within the above limits.

Total diameter of cavities, if present, estimated not to exceed 4 cm.

#### *For Advanced*

Lesions more extensive than Moderately Advanced.

### SEVERITY OF SYMPTOMS

Symptoms cannot be classified strictly. The physician's judgment must be the criterion of their severity. The following definitions are necessarily approximate:

#### *a. None.*

*b. Slight.* Constitutional and functional symptoms, such as loss of weight, ease of fatigue, and anorexia are slight and not rapidly progressive. Fever, if any, should not exceed usually one-half degree F. at any time during the twenty-four hours. Slight or moderate tachycardia. Cough, if any, is not hard or continuous; sputum, if any, may amount to one ounce or less in twenty-four hours. Sputum may be blood stained.

*c. Moderate.* Symptoms of only moderate severity; fever, if any, should not exceed usually two degrees F. No marked impairment of function, either local or constitutional, such as marked weakness, dyspnea and tachycardia. Sputum should not exceed usually two or three ounces in twenty-four hours.

*d. Severe.* Marked impairment of function, local or constitutional. Usually there are profound constitutional symptoms, such as weakness and continuous or recurrent fever. Cough often is hard and distressing and the sputum may be copious.

### CLINICAL STATUS

The following definitions, subject to the interpretation of the physician, apply regardless of the kind of treatment given. However, if some form of collapse therapy is in use at the time, this should be indicated in parentheses: for example, apparently arrested (theracoplasty).



nevertheless occurs in adults as well. The primary phase, moreover, is becoming relatively common in adults because fewer children are becoming infected. Therefore, the adjectives "childhood" and "adult" are not sufficiently limiting in their meaning. The term "(frankly) active" is now employed to include the cases formerly classified as "improved" and "unimproved" though these are retained as subdivisions.

*Differences Between Primary and Reinfection Phases.*—The differences between primary and reinfection phases of tuberculosis of the lung are set forth below as quoted from the 1940 edition:

"It is not always possible on clinical and roentgenological evidence to differentiate primary and reinfection phases of tuberculosis. Serial studies may clarify the differentiation. In either type of lesion spontaneous healing and spontaneous progression occur. It is important, however, to recognize the pathogenetic phase in which a given lesion presents itself, since such knowledge may be helpful in prognosis and treatment."

TABLE 2

DIFFERENCES BETWEEN PRIMARY AND REINFECTION PHASES OF PULMONARY TUBERCULOSIS\*

*Initial Lesion*

Primary Phase	Reinfection Phase
A single parenchymal lesion (sometimes multiple lesions) usually in the lower or mid-lung field and in the hilar lymph nodes (not always demonstrable in the living patient).	A parenchymal focus usually in the upper third of the lung without gross involvement of hilar lymph nodes.

*Prevalent Type of Retrogression*

Encapsulation, calcification, ossification.	Resorption, fibrosis and occasionally calcification.
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*Prevalent Type of Progression*

Lymphatic and hematogenous dissemination (may not be evident in adults) spread by continuity.	Bronchogenic spread, caseation, liquefaction and excavation.
---	--

*Histologic Characteristics*

Fibrotic encapsulation of caseous or calcified foci with or without decalcification.	Fibrous organization of nonresorbed infiltration, caseation and excavation.
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\* From "Diagnostic Standards and Classifications of Tuberculosis," published by the National Tuberculosis Association, 50 W. 50th St., New York.

in tuberculosis surveys conducted by health agencies throughout the country. For administrative reasons the skin test is not being used nor is it contemplated to use it in the examination of Selective Service men.

**TECHNIC AND RESULT.**—The Purified Protein Derivative (P.P.D.), which is the active principle of Old Tuberculin (O.T.), is now used exclusively in standardized doses. The second strength, reserved for nonreactors, is 250 times the strength of the first. It is without danger except in a few instances where the stronger dose has produced a severe and at times, destructive skin reaction. A positive skin reaction indicates only that the subject has had an invasion by the tubercle bacillus at some time in the past and does not indicate active tuberculosis or the extent of infection. The reactions are graded as plus, two plus, three plus and four plus. A negative reaction does not always exclude tuberculosis. It may occur in terminal cases or in one with an obsolete lesion such as a calcified pulmonary nodule. The percentage of positive reactors generally parallels the incidence of tuberculosis in the same community as determined by morbidity and mortality rates or by the x-ray evidence of the disease.

The tuberculin skin test is especially useful in the examination of contacts and of school groups, particularly if yearly observation is practicable. Whenever used in tuberculosis surveys, the positive reactors should be x-rayed. The skin test, however, is being discarded to some extent in surveys of high incidence groups, such as the colored race, and in surveys of industrial plants because of the difficulty in arranging for two or three steps or visits necessary in the process of such a survey: viz., inoculation, reading and the x-ray examination. In some instances a large number of those negative to the first test respond to the inoculation with the second strength. Frequently this number may equal or actually exceed those positive to the first test. Steps are now being taken to provide an intermediary dose about five times the strength of the first test which will become the standard for all tuberculin skin testing.

Although the x-ray is to be relied upon in the final question as to tuberculosis of the lungs, the tuberculin skin test has a very definite and useful place in clinical diagnosis and epidemiological surveys. It is quite certain that the first histological changes brought about by the tubercle bacillus will be reflected in a positive skin reaction before such lesions can be demonstrated by the x-ray. The use of the skin test as a preliminary step in tuberculosis surveys is widespread. It at least acts as a screen to eliminate negative reactors and to avoid thereby the expense of x-raying an entire group. The advent of the miniature film methods will undoubtedly restrict the use of the tuberculin skin test because of the lowered cost of films and by simplifying the administrative details of tuberculosis surveying.

*Apparently Cured*

Constitutional symptoms absent. Sputum, if any, must be found negative for tubercle bacilli, not only by concentration and microscopic examination, but also by culture or animal inoculation. In case there is no sputum, the fasting gastric contents should be obtained and similarly examined. Lesions stationary and apparently healed according to x-ray examination. These conditions shall have existed for a period of two years under ordinary conditions of life.

A considerable but undetermined percentage of apparently cured patients, particularly those who have fulfilled the above requirements not only for two but for six years, may in regard to their survival expectancy (as to tuberculosis) reach normal standards.

*Arrested*

Constitutional symptoms absent. Sputum, if any, must be concentrated and found microscopically negative for tubercle bacilli. Lesions stationary and apparently healed according to x-ray examination; no evidence of pulmonary cavity. These conditions shall have existed for a period of six months, during the last two of which the patient has been taking one hour's walking exercise twice daily, or its equivalent.

*Apparently Arrested*

Same as description of "Arrested" except the conditions shall have existed for three months.

*Quiescent*

No constitutional symptoms. Sputum, if any, may contain tubercle bacilli. Lesions stationary or retrogressive according to x-ray examination; cavity may be present. These conditions to have existed for at least two months during which time the patient has been ambulant.

*(Frankly) Active*

Improved, Unimproved

Symptoms unchanged, worse or less severe, but not completely abated. Lesions not completely healed or progressive according to x-ray examination. Sputum almost always contains tubercle bacilli.

**Diagnosis.—x-Ray Examination.**—The x-ray is now considered the most certain means of diagnosing tuberculosis in the absence of positive sputum. The physical examination alone is no longer relied upon to discover early tuberculous lesions in the lungs. This is true both in clinical diagnoses and in case finding in epidemiological surveys. It is intended that the x-ray will be used in examinations of all Selective Service men at the Army Induction Centers.

**Tuberculin Skin Test.**—The tuberculin skin test, the use of which was forbidden in the examinations of 1917 and 1918 because it was believed to be ineffective and not without danger, is now extensively employed in clinical diagnosis and

genologists and technicians and x-ray equipment, including plates and films, the expense and the administrative difficulties in setting up the machinery and utilities for this extensive undertaking which most assuredly would have slowed down the induction of the draft and the organization of the combat divisions so sorely needed in the European theater of operations.

The x-ray in 1917 did not present a picture of the lungs as it does today nor were the findings interpreted with the present-day accuracy. The pathology shown by the x-ray included blood and well organized lesions, calcifications, fibrotic patches and strands. Certain parenchymatous changes were "invisible to the x-ray because neither sufficiently congested nor sufficiently organized to cast shadows."<sup>1</sup> The usual x-ray picture at that time frequently did not disclose what are now known as minimal lesions; at least what was seen was not so interpreted. The apical cloudiness or fuzziness was frequently interpreted as pleuritic in character. Had the x-ray been employed in 1917-1918 many minimal lesions and fairly well developed cases of pulmonary tuberculosis would not have been found.

One should not conclude that the x-ray was not relied upon for diagnoses in those years. The general status of roentgenology at that time is very well summed up in the following extracts from Circular No. 20, Office of the Surgeon General, June 13, 1917:<sup>1</sup>

"Only well-marked pathological changes are revealed by radioscopy. For the accurate diagnosis of tuberculosis recourse should always be had to the study of the x-ray negative. It is not of course practicable to use radiography extensively for the determination of tuberculosis during the examination of recruits. But the x-ray will doubtless be often employed in doubtful or disputed cases. . . ."

And by the following extract from the same source which declared in substance that while the "radiograph is a very valuable, indeed, indispensable adjunct in the diagnosis of pulmonary tuberculosis it can not be relied upon exclusively for that purpose because it not only fails sometimes to reveal early tuberculosis changes but it also does not always indicate whether the lesions shown are active or absolute."

The latter part of this statement is true today, but we do have the experience of twenty years in roentgenology to give us a better idea of the activity of pulmonary lesions.

## CONTROL OF TUBERCULOSIS DURING WORLD WAR I

**Selective Service Act of 1917.**—The Act of May 18, 1917, required the registration of all male citizens between twenty-one and thirty-one years of age. Selections for the future drafts were made by lot according to numbers assigned at the time of registration. Local Boards were set up in the election districts to determine the eligibility and qualifications of registrants and to conduct examinations to eliminate obvious physical disqualifications. Men accepted for enrollment were sent to military camps or cantonments of which there were sixteen, for final examination and induction into the National Army. Calls were made about every ten days beginning in September, 1917.

**Physical Examination; the x-Ray Situation.**—Boards of Medical Department officers with representatives of the various specialties including dentistry, were organized and functioned under the direction of the Surgeon or chief medical officer of the camp. At one of the large divisional camps, three examining teams of about 50 officers each working in shifts of five hours examined as many as 2500 men per day. At this particular camp, over 50,000 examinations were made to procure the men necessary to organize an infantry division of 30,000 strength. Re-examinations numbered 8300. These included many for neuropsychiatric conditions and to satisfy various requests and complaints following the general physical examination.

The examination for pulmonary tuberculosis at the Local Boards and at the Reception Camps was part of the general physical examination. The x-ray was not used to any considerable extent in the examination of the Selective Service men in 1917 or 1918. The recommendation of specialists to include the x-ray examination of all selectees was disapproved by the War Department after careful consideration of all the factors involved in this extensive undertaking. The decision to dispense with the x-ray at that time was based on several considerations: (1) the doubtful value of the x-ray picture due to our limited knowledge of chest roentgenology at that time, and (2) the practical difficulties besetting this undertaking which were seemingly insurmountable; viz., lack of experienced roent-

Of 446,517 men of the National Guard re-examined, tuberculosis resulting in discharge from the service was found to the extent of 1.099 per cent.

*Re-examination of First Draft.*—The Selective Service men enrolled between September, 1917, and March, 1918, are referred to as the first draft. Re-examinations of these men for tuberculosis were begun early in 1918. For this extensive undertaking, some six hundred tuberculosis specialists, either commissioned officers or civilians, were specially engaged and organized into boards of not less than three to proceed from camp to camp and conduct re-examinations of the men of the first draft.

The number of special re-examinations made was 1,200,099 and 9648 cases of tuberculosis were discovered, representing a percentage of 0.803. It is to be understood that these men had been examined at the Local Boards and at the Reception Camps. At the latter places the examinations had been conducted by the general run of Medical Reserve Officers and use had been made of those who were specialists in internal medicine, including, of course, tuberculosis.

*Examination of the Second Draft.*—A different procedure prevailed in the examination of the second draft which was called March 26, 1918. Only one examination was made after these men arrived at camp but on the regular Medical Examining Boards the tuberculosis specialists functioned as part of the examining teams. These tuberculosis specialist groups comprised as many as ten examiners at the larger camps. The statistics reveal that 2,040,051 examinations were made and 12,692 cases of tuberculosis were discovered and discharged, representing a rate of 6174 per million or 0.617 per cent. Combining the results of the re-examinations of recently recruited soldiers of the Regular Army and of the first draft which had been examined previously at the Local Boards and at the Reception Camps and of the second draft which had been examined only at the Local Boards, we find a total of 3,288,669 examinations. The number of tuberculosis cases found and discharged was 22,596, which is a rate of 6871 per million or 0.687 per cent. In addition, 1481 men with tuberculosis were held in service for limited or special duties in the United States, and

### Examinations and Re-examinations for Tuberculosis.

—However, the medical profession and the Medical Department of the Army were keenly aware of the significance of tuberculosis in the military service. Steps were taken as early as June 13, 1917, to re-examine the Regular Army, the National Guard and later the first Selective Service draft by tuberculosis specialists.

*The Regular Army and National Guard.*—The Regular Army had been greatly increased by recruiting in anticipation of and immediately after our declaration of war. The National Guard was awaiting its call and draft into the Federal Service. A Tuberculosis Section was set up in the Division of Internal Medicine in the office of the Surgeon General. The advice of specialists, especially a committee of prominent members of the National Association for the Study and Prevention of Tuberculosis, was obtained and a policy was set forth in Circular No. 20, S. G. O., June 13, 1917, which also defined the duties of the examiners and gave a general description of the characteristic signs and symptoms of tuberculosis including x-ray findings and the procedure to be followed in the examination of large groups.<sup>1</sup>

Re-examination of the Regular Army and National Guard was begun in July, 1917, which was before the enrollment of selectees and the organization of the National Army. Each board consisted of at least three specialists in tuberculosis and had authority to resolve itself into a disposition board to effect the immediate discharge on certificate of disability of men who, as a result of the examination, were found to have tuberculosis. The first troops examined were those of the Regular Army in the Rocky Mountain region, followed by the officers and men in the training camps in the East and later the Regular Army in the field and the Coast Artillery. The results were as follows:

	Examinations	Cases of Tuberculosis	Percentage
Regular Army in Rocky Mt. Area ...	53,905	195	0.362
Aviation Service... ..	28,835	62	0.159
Regular Army in the Field. .	190,396	1440	0.758
Coast Artillery.....	40,296	296	0.738

These figures do not include admissions for observation for tuberculosis nor for military tuberculosis. In 1918 there were 2787 admissions for tuberculosis other than pulmonary.

The number of discharges for tuberculosis during the calendar year of 1918 (the most important year for calculations of sick and wounded) was 9410, a rate of 7.16 per 1000. The total number discharged between April 1, 1917, and December 31, 1919, white and Negro in the United States and Europe, was 20,899. In time lost by enlisted men, American troops, tuberculosis stood seventh in 1918 with 1,255,009 days. The total number of deaths from pulmonary tuberculosis in the Army from the beginning of the war to December 31, 1919, was 2240.

The death rate among Negro enlisted men in the United States during the calendar year of 1919 was three and one-third times that among white enlisted men.

**Comment.**—In the recruiting and induction plans during 1917 and 1918 the importance of tuberculosis was well realized and a special effort was made to eliminate it from the armed forces.

Specialists in tuberculosis were employed for the re-examination of the Regular Army, National Guard and the men in the first draft prior to March, 1918.

After this date a special examination for tuberculosis was a part of the general examination of all men inducted into the service during the remainder of the war. The examination at that time was restricted to a physical examination without the employment of the x-ray or tuberculin test. It is evident that it was impracticable then to use the x-ray for this purpose.

The results of the physical examinations and re-examinations are really creditable; certainly the procedure during the World War should not be considered archaic until the full story of the examinations during the emergency beginning in 1940 becomes known. The examiners found nearly 0.7 per cent of significant pulmonary tuberculosis in over three million and more than 1 per cent in nearly a half million of the National Guard. The efficiency of the special examining boards is further reflected by the small number of cases of pulmonary tuberculosis discovered as a result of the examinations prior to



108 cases of suspected tuberculosis and 613 cases of tuberculosis of other organs were recorded. To these figures must be added the 446,517 men of the National Guard among whom approximately 5900 cases of tuberculosis were found.

*Territorial Distribution.*—The highest incidence rates as discovered by the examinations and re-examinations of 1917 and 1918 were found in the southwestern states, particularly Arizona and New Mexico. Men recruited or enrolled from these areas went to camps in Texas, California and Washington where re-examinations disclosed an astounding amount of tuberculosis. This is accounted for by the fact that these men came from areas inhabited by many health seekers, populations which undoubtedly contributed generously to the Army. To illustrate—at Camp Kearney near San Diego, a National Guard organization recruited largely from Arizona, New Mexico, Utah and California, examinations of 19,827 men revealed 853 cases of pulmonary tuberculosis, an approximate rate of 4.3 per cent. Admissions to hospitals for tuberculosis at this camp for September, October, November and December of 1917 were at the annual rate of 157.53 per 1000 men. In general, the voluntary recruits and Selective Service men reflected the morbidity rates of the sections of the United States from which they came. At Fort MacArthur, California, 501 men were re-examined for tuberculosis and 103 cases were found among them—a rate of 20.55 per cent. It was found that a majority of these men came from a restricted area in Texas known for its high prevalence of tuberculosis.

*Demobilization Examinations.*—Beginning in November, 1918, the special tuberculosis examining boards were engaged in the examination of men prior to demobilization. Up to June 30, 1919, 2,500,662 men were examined, among whom 1356 cases of tuberculosis were found, a rate of 542 per million or 0.0054 per cent.

**Admissions, Discharges and Deaths.**<sup>3</sup>—The number of admissions for pulmonary tuberculosis during the World War is shown below:

Calendar year 1917	9,928
Calendar year 1918	20,391
Calendar year 1919	6,434
Total	34,753

quence of military service. Leniency characterized succeeding provisions of law until the question of service connection faded into the background. Veterans with tuberculosis whether serv-

TABLE 3<sup>6</sup>  
NUMBER OF VETERANS REMAINING UNDER HOSPITAL TREATMENT FOR PULMONARY TUBERCULOSIS AT END OF EACH FISCAL YEAR, 1919-1940, INCLUDING THOSE HOSPITALIZED FOR SERVICE-CONNECTED AND NONSERVICE-CONNECTED DISABILITIES

Fiscal Year Ending June 30	Total	Service- connected		Nonservice- connected*	
		Number	Per Cent	Number	Per Cent
1940	4,644	818	17.61	3826	82.39
1939	4,913	956	19.66	3947	80.34
1938	4,857	1,004	20.67	3853	79.33
1937	4,789	1,054	22.22	3725	77.78
1936	4,539	1,076	23.71	3463	76.29
1935	5,134	1,269	24.72	3865	75.28
1934	5,032	1,241	24.66	3791	75.34
1933	5,425	1,587	29.25	3838	70.75
1932	6,499	2,026	31.17	4473	68.83
1931	6,193	2,470	39.88	3723	60.12
1930	6,274	3,055	48.69	3219	51.31
1929	6,121	3,178	51.92	2943	48.08
1928	6,045	3,513	58.11	2532	41.89
1927	6,658	4,612	69.27	2046	30.73
1926	7,308	6,112	83.63	1196	16.37
1925	9,314	8,416	90.36	898	9.64
1924	8,082	8,082	100.00		
1923	9,577	9,577	100.00		
1922	10,849	10,849	100.00		
1921	10,337	10,337	100.00		
1920	6,018	6,018	100.00		
1919	1,362	1,362	100.00		

\* From 1925 through 1930—veterans remaining who were admitted under authority of Sec. 202-10, World War Veterans' Act 1924. From 1931 through 1933—veterans remaining who were admitted under authority of Sec. 202-10; under laws governing admission to national homes; and examinations or observations for insurance, compensation, and disability allowance. From 1934—veterans remaining for treatment of disabilities classified as nonservice-connected according to Act of March 20, 1933; also included with nonservice are veterans remaining for emergency, observation or examination for insurance, pension or compensation, and observation or examination for diagnosis.

Note.—Veterans in United States possessions not included prior to 1927.

ice-connected or not were especially favored. For many years veterans of any war suffering from tuberculosis have been eligible for hospitalization at Government expense. From Table 3 it will be seen that on June 30, 1940, 82 per cent of veterans

demobilization of over 2,500,000 men. The present-day calculations of the number of cases of tuberculosis missed in these examinations and which would be picked up by the x-ray today may be exaggerated when based on the morbidity and mortality rates in the general population as of 1917 as compared with those of 1940.

The subsequent history of the accepted men, the admission and death rates of 1918 and 1919, the results of examinations made at the time of demobilization performed under identical conditions and the Veterans Administration records seem to indicate that the tuberculosis examiners of 1918 did a good job. At least those discharged had tuberculosis. Certainly the disturbance created by the rejections based on x-ray findings, unconfirmed back home by equally competent specialists, was not a plague then as now.

#### ECONOMIC ASPECTS OF TUBERCULOSIS INCIDENT TO MILITARY SERVICE

**War Risk Insurance; Its Purpose; Subsequent Benefits to Veterans.**—Practically all tuberculous patients in hospitals at the end of the World War who required further treatment were transferred to the hospitals for veterans administered by the United States Public Health Service. Soon afterward this responsibility was taken over by the newly formed Veterans Bureau, now known as Veterans Administration. At the beginning of the war and before the draft started, the War Risk Insurance Act was passed. This Act was intended to supply a measure of security for those serving in the military establishment and thus obviate the necessity of providing pensions and other benefits as in all previous wars. Soon followed a series of congressional acts and appropriations which extended, in a very generous way, multiple benefits to World War veterans. These include hospitalization, insurance, compensation, disability allowance, vocational training (discontinued July 1, 1928) as well as benefits for certain dependents after the death of the veteran.

**Hospitalization of Tuberculous Veterans.**—Hospital care and other benefits for veterans in the first instance were intended for those who were disabled during or as a conse-

tuberculosis continued to draw \$50.00 per month after the disease had become arrested and continued to do so throughout life. Entering into the cost of compensation must be added that for dependents before and after death of the veteran. The total cost of paying compensation or pensions to World War veterans for tuberculosis is shown in Table 6.

**Insurance.**—The cost of the War Risk Insurance now known as Government Life Insurance enters into the cost of tuberculosis during the World War as does the cost of vocational training participated in by some of the tuberculous patients before 1928.

**Summary of Cost.**—The total cost to the Government of each man taken into the service with tuberculosis during the

TABLE 5<sup>a</sup>

LOCATION AND CAPITAL INVESTMENT IN TUBERCULOSIS FACILITIES OF THE VETERANS ADMINISTRATION AND THE COST OF ADMINISTERING THESE INSTITUTIONS BETWEEN MARCH 3, 1919, AND JUNE 30, 1940

Location	Amount
Castle Point, N. Y.....	\$2,740,491.01
Fort Bayard, N. M.....	1,126,836.60
Legion, Texas.....	1,418,946.23
Livermore, Calif.....	1,852,117.71
Oteen, N. C.....	2,778,885.73
Outwood, Ky.....	2,398,127.23
Rutland Heights, Mass.....	2,069,581.71
San Fernando, Calif.....	1,590,775.89
Sunmount, N. Y.....	2,519,017.88
Tucson, Ariz.....	1,793,520.84
Walla Walla, Wash.....	1,093,141.66
Whipple, Ariz.....	1,441,496.11
TOTAL.....	22,822,938.60

World War or who developed the disease during or after his service, has been estimated as between \$7000 and \$10,000.<sup>4</sup> The total cost of tuberculosis among veterans who served during the World War is rapidly nearing the \$1,000,000,000 mark.

The cost of the examination required to exclude a man with tuberculosis from the military establishment during the present emergency is infinitesimal as compared with the ultimate cost to the Government of taking a man with tuberculosis into the military service. Thus the rejection of 561 as the result of the examination of 41,819 enrollees and 9541 Guardsmen in New York State, as reported by Edwards and Ehrlich, repre-

remaining under hospital treatment for pulmonary tuberculosis were of nonservice classification. A steady decline in the census of these tuberculosis hospitals has occurred until at the end of the fiscal year 1940, only 4644 were in hospitals. It must be understood, however, that nearly 15,000 veterans are undergoing treatment for tuberculosis but are not hospitalized in veterans' institutions.

TABLE 4<sup>6</sup>

NUMBER OF CASES OF PULMONARY TUBERCULOSIS (ALL WARS) HOSPITALIZED DURING THE FISCAL YEARS 1921-1940 AND THE APPROXIMATE COST OF THE HOSPITALIZATION

Fiscal Year	Total Cases of Tuberculosis Treated	Approximate Cost
TOTAL		\$348,701,661 64
1940	16,411	9,552,646 94
1939	16,103	10,094,376 08
1938.	15,542	9,905,382 96
1937..	15,135	11,388,875 61
1936... ..	14,959	10,775,415 30
1935... ..	14,382	11,355,582 16
1934	13,615	12,766,622 12
1933.	17,869	17,430,778 80
1932	19,404	17,300,953 74
1931	17,632	18,539,941 17
1930	17,654	18,170,200 80
1929	17,466	18,036,861 00
1928	19,255	18,712,108 05
1927.	24,251	20,219,078 88
1926	26,439	23,876,982 13
1925	29,067	24,730,206 00
1924	27,858	23,400,720 00
1923	34,989	24,667,248 00
1922	44,591	29,751,114 00
1921	39,480	18,026,568 00
1920		Not available
1919		" "

Tables 4 and 5 give additional data regarding the hospitalization of tuberculous veterans.

**Compensation.**—Acts of Congress providing compensation as well as hospitalization for veterans have been liberal toward those suffering from tuberculosis, of any kind, whenever or however contracted. These monetary benefits are granted according to the degree of disability as determined by Veterans Administration officials. In addition to the rated compensation, veterans of the World War who drew compensation because of

tuberculosis continued to draw \$50.00 per month after the disease had become arrested and continued to do so throughout life. Entering into the cost of compensation must be added that for dependents before and after death of the veteran. The total cost of paying compensation or pensions to World War veterans for tuberculosis is shown in Table 6.

**Insurance.**—The cost of the War Risk Insurance now known as Government Life Insurance enters into the cost of tuberculosis during the World War as does the cost of vocational training participated in by some of the tuberculous patients before 1928.

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Location	Amount
Castle Point, N. Y.	\$2 740,491.01
Fort Bayard, N. M.	1,126 836 60
Legion, Texas	1,418,946 23
Livermore, Calif.	1 852,117 71
Oteen, N. C.	2 778,885 73
Outwood, Ky.	2,398,127.23
Rutland Heights, Mass.	2,069,581 71
San Fernando, Calif.	1,590,775 80
Sunmount, N. Y.	2,519,017 88
Tucson, Ariz.	1,793,520 84
Walla Walla, Wash.	1,093,141 66
Whipple, Ariz.	1,441,496 11
TOTAL	22 822,938 60

World War or who developed the disease during or after his service, has been estimated as between \$7000 and \$10,000.<sup>4</sup> The total cost of tuberculosis among veterans who served during the World War is rapidly nearing the \$1,000,000,000 mark.

The cost of the examination required to exclude a man with tuberculosis from the military establishment during the present emergency is infinitesimal as compared with the ultimate cost to the Government of taking a man with tuberculosis into the military service. Thus the rejection of 561 as the result of the examination of 41,819 enrollees and 9541 Guardsmen in New York State, as reported by Edwards and Ehrlich, repre-

sented a saving of \$5,610,000 based on the estimated cost of inducting these men into the Federal service.<sup>5</sup> There is no other disease group so costly in the military service except the neuro-

TABLE 6<sup>6</sup>

APPROXIMATE COST OF PAYING COMPENSATION OR PENSIONS TO WORLD WAR VETERANS FOR TUBERCULOSIS, SERVICE-CONNECTED AND NONSERVICE-CONNECTED, FOR FISCAL YEARS 1919-1940

Fiscal Year	World War Service-connected Pulmonary Tuberculosis		World War Nonservice-connected	
	Cases on Rolls at End of Year	Estimated Disbursements	Cases on Rolls at End of Year	Estimated Disbursements
TOTAL		\$854,647,911		\$18,151,863
1940	54,855	35,490,848	9,621	3,111,630
1939	55,634	36,284,013	9,125	2,974,116
1938	56,389	36,961,282	8,430	2,766,084
1937	56,953	37,835,199	7,554	2,519,554
1936	58,092	39,218,136	6,775	2,310,870
1935	59,141	40,723,086	6,829	2,333,729
1934	57,270	33,213,528	6,756	2,135,880
1933	63,932	48,110,128	Not available	
1932	63,371	50,450,092	"	"
1931	59,739	50,819,459	"	"
1930	55,598	44,707,672	Not in effect	
1929	56,535	47,704,783	"	"
1928	60,690	50,951,043	"	"
1927	57,748	50,228,806	"	"
1926	48,150	42,562,626	"	"
1925	45,839	37,469,064	"	"
1924	39,099	35,091,509	"	"
1923	41,551	42,825,020	"	"
1922	36,600	37,722,156	"	"
1921	29,442	30,344,692	"	"
1920	23,091	23,798,970	"	"
1919.	5,526	2,135,799	"	"

psychiatric, and in that group there is no communicable disease problem affecting public welfare.

#### CONTROL OF TUBERCULOSIS IN THE PRESENT MILITARY EMERGENCY

The significance of pulmonary tuberculosis in the military service has come to be realized in its true importance as a result of our experience during the World War. Our present conception of the pathogenesis and epidemiology of this disease

which has rationalized the methods employed in the campaign against tuberculosis, together with the development of the  $x$ -ray as an instrument of precision in discovering early tuberculosis, enable us to approach the present military mobilization with more confidence. Furthermore, the problem is affected by the decrease in the prevalence of tuberculosis as indicated by the annual mortality rate for pulmonary tuberculosis in the general population from 123.8 per 100,000 in 1916 to 43.2 in 1939.

**Selective Service Act.**—The Selective Service Act of September 16, 1940, sets the age limit for induction at twenty-one to thirty-six years (since amended to twenty-one to twenty-eight years). The administrative machinery with its headquarters at Washington is known as the Selective Service System and functions under the direction of the Administrator of the Federal Security Agency. The states are charged with the procurement of quotas required from time to time under the military mobilization plans. Local Boards are set up very much as in 1917. Available to the Local Boards are the Advisory Boards and Appeal Boards. The physical examination at the Local Boards is again, as in the World War, a weeding out or screening examination, to eliminate those with obvious defects which can be found by ordinary examinations.  $x$ -Ray examinations of the chest are not made at the Local Boards except in scattered instances such as the procedure carried out in Delaware where some 2000 registrants have been examined at sanatoria and hospitals in opposite sections of the State.<sup>7</sup>

Registrants accepted by the Local Boards are forwarded on call to the Army Induction Centers which are established and administered by the War Department through Corps Area supervision. The men found disqualified as the result of the examination at the Induction Centers are immediately rejected and returned to their homes. The men accepted are formally inducted and forwarded immediately to the Army Reception Centers for further processing and distribution to training camps and military units. An experimental plan has been placed in operation in Pennsylvania beginning May 21, 1941, under the provision of which the Army Induction Centers, of which there are now eight in the State, became Army Examining Centers. The men found qualified at these examining centers,



instead of being forwarded immediately to Army Reception Centers, are returned to their homes for a period of at least ten days before being sent to the Reception Centers where final induction takes place. This plan is intended to give further opportunity for the accepted men to adjust their personal affairs which heretofore could be made only provisionally pending the result of the final examination.

Voluntary recruiting so far has met the requirements of the Navy and Marine Corps.

**The Physical Examinations.**—Early in 1940 the Subcommittee on Tuberculosis of the Committee on Medicine was organized by the National Research Council to act in an advisory capacity to the medical service of the Army and Navy. This subcommittee advised  $x$ -ray examination of the lungs of all Selective Service men.

Upon the recommendation of the Surgeon General, the War Department directed that an  $x$ -ray examination of the chest of every enrollee be a part of the physical examination at the Army Induction Centers. The Subcommittee on Radiology of the Committee on Surgery began a survey and classification of the specialists in roentgenology throughout the country in order to obtain the services of at least one for each Induction Center and others for the general roentgenological service throughout the military establishment. One such radiologist, engaged by Corps Area authorities, is to be attached so far as practicable to the board of examiners of each Induction Center.

The  $x$ -ray examinations so far have been made for the Induction Centers by the State and City Health Departments, military and civilian hospitals and laboratories engaged by Corps Area authorities and financed by funds set up by the War Department. So far the Induction Centers have used only the 14 by 17 inch celluloid films or the rapid process paper films, either in rolls or in cut sheets. Upon completion of the examinations, the films are forwarded to Washington to become a part of the permanent records. The fluoroscope has not been used in these examinations because this method presents even more difficulties in diagnosis than the roentgenogram and leaves no permanent record. The newer methods of photo-fluorography, photographing the fluorescent screen image on

miniature films, 4 by 5 inches or 35 mm. in size with or without the stereoscopic attachment, have not yet come into general use although about forty-five of the 4 by 5 inch units have been purchased by the Surgeon General of the Army.

**Physical Standards.**—Mobilization Regulation 1-9 (MR 1-9) is a document published by the War Department August 1, 1940, setting forth the standards of physical examinations during mobilization of enlisted volunteers for the Regular Army and Selective Service men. These standards have been published in Selective Service Regulations, Volume 6, entitled "Physical Standards" which also contains general information and instructions regarding the conduct of the physical examination of selectees. These regulations are to be used as a guide by Local Boards and Induction Centers.

Physical standards for acceptance as well as disqualifying defects with reference to pulmonary tuberculosis are defined in these regulations. The requirements for acceptance are a normal respiratory system and chest wall, with certain exceptions relating to arrested pulmonary tuberculosis described later.

*Disqualifying defects are:*

- A. Tuberculosis of lungs or tracheobronchial lymph nodes, with exceptions to be noted later.
- B. Fibrinous or serofibrinous tuberculous pleuritis, and pleurisy with effusion of unknown origin. (Inasmuch as pleurisy, with or without effusion, is a very frequent manifestation of early tuberculosis, examining physicians should examine with the greatest care registrants who have apparently recovered from pleurisy.)
- C. Empyema, or unhealed sinuses of the chest wall following operation for empyema.

*The following conditions are acceptable:*

- A. Arrested pulmonary tuberculosis consisting of lesions appearing in x-ray examination as small apical scars, small calcified nodules or localized fibrous strands, in no case exceeding minimal extent as defined in the classification of the National Tuberculosis Association, and when, in addition, in the opinion of the examining physician, this lesion is not likely to be reactivated under conditions of military service.
- B. Minimal pulmonary lesions are defined as slight lesions without demonstrable excavation confined to a small part of one or both lungs. The total extent of the lesions, regardless of distribution, will not exceed the equivalent of the volume of lung tissue which lies above the second chondrosternal junction and the spine of the fourth or body of the fifth thoracic vertebra on one side.

From reports received from Examining Boards, it appears that there is not only misunderstanding of these regulations but lack of uniformity in interpreting the x-ray findings. There is also some disagreement among specialists in tuberculosis as to the wisdom of accepting for military service men in their twenties with reinfection tuberculosis, the stability of which cannot well be determined by either the physical examination or the x-ray. It is known that a revision of physical standards is in progress.

**Hospitalization and Disposition of Men with Tuberculosis.**—Circular No. 44, War Department, March, 1941, defines the policy governing hospitalization and disposition of enlisted men suffering from pulmonary tuberculosis:

"Enlisted men developing tuberculosis in line of duty will, unless terminal cases, be discharged and transferred to Veterans Administration facilities as soon as a definite diagnosis of tuberculosis and disablement for further military service are determined. Exception to this policy may be made in the case of men nearing retirement for thirty years of service, and noncommissioned officers of the first three grades when the prognosis is favorable for a complete recovery and restoration to unlimited duty within one year. Such individuals will upon approval of proper authority be transferred to Fitzsimons General Hospital or other designated Army hospitals for treatment. Enlisted men who are found to have pulmonary tuberculosis not in line of duty, if in need of hospital care, will be transferred to Fitzsimons General Hospital or other designated Army hospitals. If not in need of hospital care, enlisted men showing evidence of pulmonary tuberculosis in excess of that acceptable for military service under the provisions of MR 1-9, incurred not in line of duty, will be discharged on certificate of disability to their own care."

It will be seen that provision has been made for the hospital care of *all enlisted men* of the existing military establishment having tuberculosis provided they need hospital care. Those whose disease was contracted in line of duty are to be discharged and transferred to Veterans Facilities; those not in line of duty may be treated in Army hospitals. Included in this class are those who at any time after induction are found to have tuberculosis in excess of that acceptable for military service. As many men have been inducted without having had an x-ray examination of the chest, re-examination will disclose many men "showing evidence of pulmonary tuberculosis in excess of that acceptable for military service under the provisions of MR 1-9."

*Line of Duty.*—The general regulations governing line of duty as found in Army Regulation 40-1025 are as follows:

- a. Ordinary Cases.—All diseases or injuries from which a militarized person suffers while in the active military service of the United States may be assumed to have occurred in the line of duty, unless the medical officer knows that the disease or injury—
- (1) Existed prior to entry in the service;
  - (2) Was contracted while absent from duty without permission;
  - (3) Occurred as the result of something which he was doing in pursuance of a private avocation or business;
  - (4) Grew out of relations unconnected with the service or was not the logical incidence or probable effect of duty in the service (see paragraph 10b [1], AR 615-360); or occurred in consequence of willful neglect or misconduct of the man himself.

Referring to tuberculosis these regulations provide as follows:

- (4) Tuberculosis.—Cases of acute tuberculosis (not including acute exacerbations of chronic forms) will be considered to be in line of duty in all instances, irrespective of length of service. Cases of active chronic tuberculosis in military personnel with more than six months' service will be considered to be in line of duty regardless of the character and the extent of the lesion. Inactive pulmonary tuberculosis, diagnosed on the basis of x-ray findings alone, will be considered to be not in line of duty unless there is a previous record of active pulmonary tuberculosis while in the military service. Cases of chronic tuberculosis including acute exacerbations, in which the length of service is six months or less, will be considered to be not in line of duty."

**Estimate of the Extent of Tuberculosis to be Found in the Draft.**—Accurate statistical data as to the percentage of tuberculosis found by the Local Boards and Army Induction Boards during the first draft throughout the United States are not yet available. Early reports from the southern part of New York State of the x-ray examinations of about 6600 enrollees of which a little more than 2 per cent were Negroes showed a rate of 1.46 per cent of tuberculosis rejectable under existing regulations as determined by the x-ray examinations under existing regulations. Almost exactly the same percentage, 1.47, was found at the same time in Pennsylvania. It is understood that the rate in New York has been found subsequently to be considerably less, being 1.1 per cent among 35,210 men examined at Induction Centers up to March 31, 1941, while that in Pennsylvania is greater.

In Pennsylvania as of July 1, 1941, there have been examined at the Army Induction Centers (known as Army Examining Centers since May 21, 1941) 51,131 men. Every one of these men was x-rayed by use of the 14 by 17 inch celluloid or the paper film. The number of men rejected for military service on account of tuberculosis was 1169 or a percentage of 2.12. All of these men had been through the Local Board examinations. A study of the records of the Local Boards in Pennsylvania showed that, of 100,000 enrollees examined, 633 were rejected because of tuberculosis, or a percentage of 0.0063.

Even when the statistics of the first draft throughout the United States have been compiled, the incidence of pulmonary tuberculosis in Selective Service men will not be known because, as late as May, 1941, not many more than 50 per cent of men actually inducted had had an x-ray examination of the chest.

The number of men of the first draft (November 1940-July 1, 1941) is approximately 800,000. Although accurate statistics are not available, the latest estimates soon after July 1, 1941, indicate that probably 1,400,000 registrants were examined to procure these 800,000 men. Current reports indicate that the second draft will number approximately 900,000. For these 1,700,000 recruits it may be assumed that 2,800,000 men will be examined.

It is quite probable that definite information as to the percentage of tuberculosis among registrants will never be known because the examinations at the Local Boards are being made without the use of the x-ray and many men rejected for other causes probably have tuberculosis also. It is too early to arrive at a reliable estimate from Induction Board figures as not all of these are using the x-ray in the physical examinations. One would hesitate to apply to this study the figures disclosed by the examination of 100,000 men at the Local Boards and 55,000 men examined at the Army Induction Centers in the State of Pennsylvania. The rate is well over 2 per cent. It should be higher throughout the United States in which the mortality rate for pulmonary tuberculosis was 43.2 per 100,000 of the population in 1939, while the rate in Pennsylvania was 39.7.

*Failure of Later Observations to Confirm Diagnosis Based on x-Ray Findings.*—More thorough observation in hospitals and clinics of men rejected for pulmonary tuberculosis has not confirmed the diagnosis or the actual x-ray findings in innumerable instances. It is believed that there are two reasons for these results:

1. Failure of the Induction Examining Boards to make use of the Diagnostic Standards and Classification of Tuberculosis as defined by the National Tuberculosis Association. At least twelve ways of reporting rejections, presumably for pulmonary tuberculosis, are observed in the records of the 55,000 enrollee examinations made at the Induction Centers in Pennsylvania, viz., "tuberculosis," "pulmonary tuberculosis," "pulmonary tuberculosis active," "pulmonary tuberculosis inactive," "pulmonary tuberculosis arrested," "pulmonary tuberculosis unstable," "pulmonary tuberculosis healed," "tuberculosis incipient," "pulmonary tuberculosis reinfection phase" or type, "pathological chest" and "lungs."

2. Failure of the Induction Examining Boards, particularly the roentgenologists, to follow the regulations governing acceptance and rejection as laid down by Mobilization Regulations 1-9 and published in Selective Service Regulations, Volume 6, entitled Physical Standards.

In support of the medical examiners at the Local Boards and Induction Centers it should be understood that these examinations are not for the sole purpose of establishing a diagnosis or to determine the ability of a man to go about his customary business, a consideration which often determines the practicing physician's decision. The object of recruit examinations is to select men fit for military service, not temporarily and under guarded conditions, but for years of such service, the possible nature and environment of which should be considered. Standards for these two purposes necessarily differ. The percentage of men disqualified for military service in 1917 and 1918 was large and will be so now, a fact which the American people should understand.

*Suggestions for the Correction of Some of the Difficulties Encountered in the Final Physical Examinations.*—1. Restatement of standards for acceptance and rejection relating to

tuberculosis. These regulations should be more definite and concise and leave less to the discretion of the examiner as to the likelihood of reactivation of demonstrated lesions. Most of the criticism encountered is directed toward the policy of accepting men in their early twenties with reinfection phase of tuberculosis.

2. Insistence on the use of definite diagnostic standards and classification of tuberculosis. Something might be accomplished if acceptable terms in reporting x-ray findings for this purpose were limited in number. Such a policy has improved the professional and statistical value of the reports of sick and wounded of the Army and Navy.

3. A supervisory service. The preparation of the wisest and most definite and complete regulations is not enough. The physical examination of millions of men by examiners of various shades of professional opinion and experience, making their diagnosis of tuberculosis almost wholly by the x-ray and completing examinations often in a hurry to enable the enrollees to leave town before night, calls for a corps of field supervisors to insure thorough understanding and observance of regulations and procedures by the Induction Board examiners.

#### THE EPIDEMIOLOGIC FOLLOW-UP AND REHABILITATION OF SELECTIVE SERVICE MEN REJECTED BECAUSE OF TUBER- CULOSIS

**The Problem.**—Rejection of a substantial proportion of all registrants for military service suggests the opportunity of bringing these hitherto unknown diseases and physical disqualifications to the attention of the men themselves and of invoking the services of the medical profession and health agencies toward their correction or the application of measures to safeguard the public health. Among the causes of rejections are many communicable diseases which by law are required to be reported. Among these is tuberculosis.

In 1918 when it was determined that at least 30 per cent of the men between twenty-one and thirty-one years of age were being found physically disqualified for military service, a plan was adopted to accept men with certain remediable physical defects and to segregate them in organizations attached to the

Depot Brigade at the divisional camps and there to institute a system of rehabilitation by medical treatment, surgical operations and physical training to reclaim them for military service even of a limited kind. The results were rather indefinite as the plan was never thoroughly developed. The Remediable Defects Battalion of the American Expeditionary Force rendered effective service in restoring to duty status many men with purely physical defects, especially orthopedic cases.

Much consideration has been given recently by the Selective Service System, under the urge of professional groups in and outside the Government, to enroll men with certain classes of physical defects, especially venereal disease and remediable dental conditions, for treatment and restoration to duty status. At the same time plans to restore rejected men to effective citizenship through medical and dental treatment and hospitalization were considered. Federal authorization and appropriations for the latter purpose have not materialized. Under the Selective Service Act each state is responsible for supplying its quota of men. They remain citizens of the State until the last act in the process of selection is accomplished—induction or muster into the Federal Service. Those found disqualified are returned to the state. It follows, therefore, that their epidemiological follow-up and rehabilitation are the responsibility of the State, its official agencies and health organization so far as authorized and in the broadest sense of the practice of medicine and dentistry.

**The Pennsylvania Plan.**—In Pennsylvania, as in many other states and municipalities, government facilities are available for the care of the tuberculous, venereal and psychiatric patients who are unable to command the services of private physicians and hospitalization. These should be made available to Selective Service men rejected for conditions of this kind. The epidemiological follow-up and rehabilitation of Selective Service men rejected for tuberculosis as well as for venereal and neuropsychiatric conditions was begun in Pennsylvania in November, 1940. The Bureau of Tuberculosis Control of the State Health Department has had access to the records of the Local Boards as they pass through the office of the State Director of Selective Service at Harrisburg en route to Washington.



Likewise, the reports of all men rejected at the Army Induction Centers are received through the courtesy of the Headquarters of the Third Corps Area at Baltimore. The existing agencies of the State Health Department for the control of tuberculosis, namely, the State Tuberculosis Clinics, Pneumothorax Centers and Sanatoria are utilized for this purpose. The name, address and, if available, the name and address of the family physician of each man rejected for the military service on account of tuberculosis are reported to the nearest State Tuberculosis Clinic, of which there are eighty-eight in Pennsylvania, with directions that the Clinician contact the family physician if possible, otherwise locate the rejected man and offer the services of the Clinic, particularly for epidemiological investigation to determine the source of infection and to examine and observe the contacts. Those who are eligible are admitted to the State Tuberculosis Sanatoria. So far all men rejected for tuberculosis as a result of the examination of more than 100,000 at the Local Boards and nearly 60,000 at the Induction Centers, have been so reported and steps taken to initiate an epidemiological investigation in each case and to place the men under medical treatment in appropriate instances.

The Selective Service physical examinations constitute a case-finding project on a large scale which offers an extraordinary opportunity for the epidemiological follow-up and rehabilitation by health agencies in thousands of cases of tuberculosis, an opportunity not to be neglected.

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## COMMUNICABLE DISEASES AND MILITARY MEDICINE\*

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### RESPONSIBILITIES OF THE MEDICAL DEPARTMENT

THE manpower of the Army consists only of those men who are actually ready for arduous duty. The most important functions of the Medical Department of the Army are those of selecting healthy men and then of maintaining their health and bodily vigor. The new medical officer in the Army will observe less relative emphasis on therapy and far more on prevention and control of disease than he has ordinarily met in civilian life. Although efforts to diagnose disease and cure the Army patient are made with equal care and with the most effective scientific means at the command of modern medicine, the military mission, it must be remembered, demands that *prevention* be the order of every day—applicable constantly and unremittingly.

Although every physician knows that sources of infection

\* The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the War Department or the military service at large.

The scope of this paper is not intended to be all-inclusive; it concerns mainly the fundamentals of the problem as indicated by the communicable disease experience of World War I. Tuberculosis and skin diseases are discussed in other papers of this volume.

and contacts should be determined in every case of communicable disease, he finds that procedures which *should* be followed in civilian life *must* be carried through in military organizations. *Prompt isolation and strict quarantine are routine in the Army.* The physician who has been prevented by circumstances beyond his control from using these preventive measures in his private practice is usually gratified by the opportunity to apply them during his Army experience. Many factors which tend to neutralize the doctor's efforts in civilian medical practice do not affect military relationships. On his return to civil life, he is likely to be more insistent upon the application of preventive measures than he was prior to his military experience.

Isolation and quarantine, followed by prompt and thorough epidemiological investigation, remain the most effective means of preventing the spread of a disease once a case has been recognized, but true preventive work starts even before the first case has been reported. In the Army, the stable door must be locked—*all the time*. Just as war itself is a relatively primitive means of dealing with a problem, so also many of the diseases which often follow in its wake are likely to be the old, well-understood, and easily preventable ones. With only slight relaxation of preventive measures the infections of greatest military significance might easily again become those associated with environmental sanitation. In World War I, no such relaxation of any magnitude was forced upon us. Intestinal diseases were, for the first time in any war, of minor importance. Successful control of them permitted the respiratory and venereal diseases to be all the more conspicuous as high-ranking causes of death and disability.

Recent developments indicate that we are well on the way toward control of the environment with regard to respiratory infections also. The potential usefulness of ultraviolet radiation<sup>1, 2</sup> and of aerosols<sup>3, 4</sup> in reducing the incidence of airborne infections among people concentrated in enclosures has been clearly demonstrated. If these means of killing the etio-logic agents of the upper respiratory infections prove to have equal effectiveness in large-scale practice, there will be still another triumph over the environment.

The new medical officer will find high standards of environmental sanitation in the Army as a result of the daily investigations made by the medical inspector. This individual corresponds to the health officer of a municipality, except that the medical inspector is personally responsible to the Surgeon of his division for the continuous health of the men. To be sure, the Commanding Officer of the organization or command—a *line* officer—has final responsibility for the health of his troops, but the Surgeon functions as his official and technical advisor. Through the medical inspector the Surgeon keeps himself informed with regard to all matters that may affect the health and well-being of the troops.

#### PROBLEMS RESULTING FROM MOBILIZATION

Bringing men from widely different environments, both personal and geographic, into the close contact that military training requires, creates a situation which is favorable to explosive outbreaks and an accelerated spread of infectious diseases. The reasons for this often demonstrated fact fall into two categories. First, the close and unaccustomed proximity of men in squad rooms, barracks, mess halls and recreation centers offers conditions which facilitate the physical transmission of the etiologic agents, especially those of the upper respiratory type. Second, some of the men, whose experience both with disease and subclinical exposure to even the usually minor infections of childhood are different, may be less resistant to strains of organisms in another area. Both the close physical contact and the changed personal routine favor the rapid spread of infections if they are introduced.

The fact that those artificial conditions produced by rapid mobilization favor the etiologic agents of infectious diseases, means that carefully planned procedures must be followed to counteract the ease of transmission of the organism and also to avoid too sudden geographic shifts which may render the men vulnerable to infection if exposed.<sup>5</sup> The physiological explanations which no doubt exist for the differences between unconditioned men and seasoned troops cannot yet be made specifically, but our experience in 1917 leaves no question about the facts.

Studies since the mobilization of 1917-1918 show that the *incidence* of the common communicable diseases bears an inverse relationship to the *length of service*.<sup>6</sup> Wheelis<sup>7</sup> found that the incidence of measles, mumps, etc., among recruits with less than two months' service was two to four times as great as among men with more than two months' service.

For only a few of the common respiratory diseases can we claim specific weapons of prevention. For the most part these have been developed since the last war. In sections which follow a discussion of the more recent advances in the fields of prevention and treatment of certain important diseases will be offered. In this short paper no claim for originality or completeness can be made. It merely brings together the results of investigation in several fields.

#### CLASSIFICATION AND RELATIVE IMPORTANCE OF THE COMMUNICABLE DISEASES IN THE ARMY\*

**Higher Age Incidence among Military Personnel.**—The communicable diseases affecting military personnel differ in certain respects from those in civilian populations. They occur with greater frequency in age groups which are not so often subject to epidemics in civilian life. *Mumps*, for example, occurs most frequently in civilian life at ages nine and ten. Serious epidemics of mumps occurred during the 1918 campaign in men over twenty and these outbreaks were more severe than the epidemics in younger persons. *Influenza* complicated by pneumonia was more fatal among soldiers from rural sections than among those from urban areas.<sup>9</sup> *Meningococcal meningitis* which occurs most frequently in the first decade of civilian life, occasionally becomes an epidemic disease in the third decade under the conditions of mobilization. Innumerable variables go to make up nature's immunologic balance sheet but mobilization is enough to put her in a tailspin by upsetting her equilibrium. From the standpoint of pathogenesis there are no essential changes produced by mobilization, unless in mumps it increases the incidence of extraparotid glandular involvement.

\* Since this study was prepared, the following paper which is pertinent to the subject has appeared: Pepper, O. H. Perry, Disease Expectancy in the New Army War Medicine, 1: 463-469 (July) 1941.

Epidemics of *measles* seldom occur in the third decade of life in civilian populations but there were 96,817 cases in the Army during 1917-1919. It is difficult, however, to say that the disease differs in any significant fashion, except in age of occurrence. These points of dissimilarity of incidence are real and a study of them may provide clues to certain communicable disease problems that confront us. The differences do not appear to be very important, however, from the standpoint of immediate control of outbreaks.

**Comparable Incidence of the Communicable Diseases in the Army.**—For convenience, the communicable diseases are classified in military records under these five headings: intestinal, respiratory, insect-borne, venereal, and miscellaneous.<sup>10</sup> Medical officers writing during the war of 1918 recognized the relative shift of importance from the *intestinal diseases* to the respiratory diseases.<sup>5</sup> The improved sanitary methods for handling water, milk and other foods, and body wastes had already diminished the occurrence of the enteric diseases until they were even then infrequent, though they still remain as grave potential dangers. As has already been noted, their menace is always present because the military exigency may make suddenly necessary the discarding of all elements that go to build up environmental sanitation.

Of these five groups, the *respiratory diseases* accounted for more deaths during the mobilization of 1918-1919 than all other diseases together. Table 1 gives the relative incidence of the various communicable diseases as they occurred in the total armed forces (American troops only) from April 1, 1917, to December 31, 1919. Typhoid fever, so important in earlier wars, was crowded out of the big league causes of disability (1527 cases). It ranked higher as a cause of death than of disability (227 deaths).

One observes from this table that the *common communicable diseases of childhood* were unusually prevalent. Mumps and measles ranked third and fourth respectively as causes of disability, and personal experience corroborates the contention that they are likely to be major problems during the present conflict.

Turning from the experience of earlier wars to the present

emergency we find that there occurred during the fall of 1940 a rather sharp outbreak of influenza in the United States Army. The course of this epidemic as it traveled across the country from west to east has been described for the civilian population.<sup>11</sup> A few camps have had provisional weekly rates per 1000 of pneumonia, measles, scarlet fever, and mumps as high as 3.73, 15.95, 11.58 and 10.14 respectively<sup>12</sup> However, no outbreaks of alarming importance have been reported during this mobilization.

The prediction has been made that the incidence of certain minor communicable diseases will be lower during this mobil-

TABLE 1

ADMISSIONS AND DEATHS FOR COMMUNICABLE DISEASES IN THE TOTAL U. S. ARMY (AMERICAN TROOPS) APRIL 1, 1917, TO DECEMBER 31, 1919 INCLUSIVE\*

Cause	Number of Admissions	Number of Deaths	Case Fatality (Per Cent)
Influenza.....	783,895	24,575	3.14
Venereal diseases	356,151	170	.05
Mumps...	229,680	0	0
Measles.....	96,817	2,367	2.45
Pneumonia (broncho-, lobar)	77,911	19,091	24.50
Tuberculosis ...	38,071	2,744	7.21
Measles, German	17,039	82	.48
Scarlet fever..	11,673	354	3.03
Malarial fevers	14,111	31	.22
Diphtheria....	10,907	177	1.62
Meningitis...	4,826	1,833	37.98
Typhoid fever.	1,527	227	14.86

\* Medical Department of the United States Army in the World War, Vol. XV, Part 2, Medical and Casualty Statistics, 1925, pp. 86-165.

ization than in that of 1917-1918. Three probable factors support this forecast: (1) the strength of the current army has increased at a slower rate than during the former period due to the more gradual mobilization<sup>74</sup>; (2) among those recruited for this emergency are men who have had service in the Civilian Conservation Corps, where many acquired active immunity to various diseases; (3) during the past twenty-years there has been a relative population shift from rural to urban areas, and motor transportation and facilities for travel have been extensively improved. This tendency toward increased

aggregation leads to higher attack rates for certain respiratory diseases among young persons, resulting in a higher degree of immunity among prospective recruits.

In England, up until May, 1941, there had been observed a slight increase in the civilian rate for enteric diseases. Only one disease, meningococcal meningitis, has occurred in epidemic proportions. It increased from a yearly number between 1000 and 1500 cases to nearly 14,000 in 1940. Its incidence has been a major problem in certain areas.<sup>13</sup>

The following report on the incidence of communicable diseases in the German Army appeared in the New York Times, July 27, 1941:

"Not a single German soldier had contracted typhoid fever, paratyphoid, cholera, smallpox or dysentery in the campaign in the East, it is reported. Only one case of malaria has been reported since June 22.

"The reason for this apparent immunity of the German soldiers, it is said, is that they were inoculated against every disease that might be contracted in Russia and for which vaccine exists.

"The Germans declare, moreover, that no infectious diseases of any kind have been contracted by their men. The reason, they say, is that the German soldiers in this campaign have had no time to come into contact with any portion of the enemy's civilian population."

#### DISEASES CAUSED BY VIRUSES

**Influenza.—TREATMENT.**—The management of the individual case of influenza is essentially one of *bed rest* in a place of isolation, with adequate *nursing care*. The isolation is intended to do two things: remove a focus of infection from the group and, what is probably more important, protect the patient from secondary invaders. The various chemotherapeutic measures have little beneficial effect on uncomplicated influenza. It has been recommended, however, and logically so, that small doses of *sulfanilamide* or *sulfathiazole* (1 to 3 gm. a day) be given to patients with influenza, as a measure to prevent complications. The pharmacology and methods of administration of the various chemotherapeutic agents are admirably covered in Flippin's article in this symposium.

**PREVENTION AND CONTROL.**—The great 1918 pandemic of influenza instigated a rash of investigative ventures to determine the etiology, preventive measures, and treatment of this dreaded disease. Great progress has been made in the identifi-



cation of several viruses as causes of the different types of the clinical syndrome known as influenza.<sup>14, 15</sup> *Vaccines*, developed by several investigators,<sup>16, 17, 18</sup> have had partial clinical trials, but the results of their use during the mild epidemics of the past four years have not been encouraging.<sup>19</sup> Epidemiologically the disease is most certainly spread by droplets and droplet nuclei, possibly by eating utensils.<sup>20a</sup> Measures that interrupt the infection chain for other respiratory diseases (such as isolation of cases, avoidance of crowded places, encouragement of the use of the handkerchief, etc.) should be employed in the face of an outbreak of influenza.

The problem concerning the bacterial filtering efficiency of gauze masks has been recently reinvestigated with encouraging results.<sup>21</sup> A new point of attack on the influenza problem has been taken up by Francis and Stuart-Harris.<sup>22, 23</sup> They have demonstrated a type of local resistance displayed by the cells of the nasal mucosa to reinfections with influenza virus, and also that there is an *inactivating* (or *protecting*) *substance* in the nasal secretion which varies in amount at different ages. For example, this protecting substance was found less commonly among New Yorkers of ages twenty to twenty-nine than among those of younger ages. The eventual identification of this protecting substance may have great value in controlling this disease. Wells and Henle<sup>24</sup> found that air infected with influenza A virus will regularly cause death in white mice. They also learned that air-virus mixture, irradiated with ultraviolet light, did not kill the mice. The use of *ultraviolet radiation* as a control measure for air-borne infections will be considered later under measles.

Influenza offers a problem in *immunity* similar in some respects to measles. It was noted by Irons<sup>9</sup> that "the case fatality at Camp Dix among those who came from cities of 10,000 or more was 10.8 while among those from rural homes it was 15.8." This difference provides an additional cogent argument for increased epidemiologic studies of this and the other important respiratory diseases.

**Measles.—TREATMENT.**—The treatment of the individual case of measles offers no special problem unless some complication arises. Prompt *isolation* of the patient is the most impor-

tant factor in preventing these complications. The use of *sulfanilamide* or *sulfathiazole* in small daily doses is a useful procedure since most of the complications of measles are caused by the hemolytic streptococcus. It should be emphasized that more will be gained by preventing complications than by treating them after they arise.

**PREVENTION AND CONTROL.**—Great progress has been made in the field of measles prevention. Since the last war a more general use of *convalescent serum* has proved efficacious in providing temporary immunity for the individual. *Immune globulin* or human *placental extract*<sup>25</sup> has a similar effect and when either of these agents is used at the proper time during the incubation period measles may be prevented or modified. Convalescent serum in doses of 40 to 50 cc. has been advocated to treat the measles patient in the pre-eruptive stage. This measure has been shown by Kahn and his associates to lessen the severity of the eruptive stage (cited by Stimson<sup>26</sup>). The judicious use of these agents may take the Blitz out of a measles outbreak even though the number of cases is not materially reduced. A vaccine<sup>27</sup> has had limited clinical trial with encouraging results.

In groups of newly mobilized men the *immunity status* of the groups as a whole might be studied with profitable results. A modern weapon against measles (as well as diphtheria) has been found in the statistical knowledge of the immunity composition of the population. Measles is certain to visit newly drafted manpower. The explosiveness and severity of the outbreaks might be averted by the proper mixing of immunes with nonimmunes. During the first critical year of mobilization the military situation might be such that attention could be paid to the immunity composition of the various mobilized groups for measles, mumps, and chickenpox so that a rational employment of segregation can be made to lessen the seriousness of their epidemics.

**Drop-let Nuclei in Transmission of Air-borne Infections.**—The high infectiousness of measles has caused increased attention to be given to the environmental control of the spread of the etiologic agent. The term "air-borne infection" has become a medical commonplace. Wells<sup>28</sup> has devised an instrument

(an air centrifuge) to evaluate air as a disease-transmitting agent. For many years secretion droplets (Flügge droplets) have been incriminated as transmitters of many disease-producing agents. The heavier secretion droplets thrown out in coughing or sneezing—or in ordinary talk—soon fall to the floor and become relatively unimportant. The smaller droplets—those below a certain measured size, many of them containing bacteria—continue to float in the air and soon evaporate leaving their bacteria suspended. The bacteria and dust particles are so light that they have little tendency to settle out of the air, and are carried about on the air currents. It is this group of smaller droplets that has received the focus of attention in recent years. Much progress has been made in the study of the particulate matter of industrial dusts, and one of the emergent principles of these studies is that the mode of action of a substance depends not only on its chemical composition but also on its particle size.<sup>29</sup> A large number of physiologic problems concerning the relationship of droplet nuclei and the human respiratory tract await solution.

*Ultraviolet Irradiation as a Control Measure.*—Wells has shown that the proper amount of ultraviolet irradiation will kill the organisms causing scarlet fever, tuberculosis, chickenpox and influenza that are found floating on droplet nuclei. Experiments conducted by Wells and Wells (reported at the Cleveland meeting of the American Medical Association, June, 1941) with ultraviolet radiation in classrooms during an outbreak of measles have shown fewer cases among children in the irradiated rooms as compared with control groups. Greene and coworkers<sup>30</sup> have shown that ultraviolet radiation is effective in controlling chickenpox in hospital wards. Mundo and McKhann<sup>31</sup> reduced the incidence of hospital ward infections from 12.5 to 2.7 per cent by the use of ultraviolet lights around cubicles. The more widespread employment of this principle to the control of communicable disease offers great promise.

**The Common Cold.**—There is little doubt that the common cold is the most frequent of all communicable diseases. There seems to be general agreement also that the common cold is not one disease but a group of diseases or symptom complexes, some caused by bacterial agents, others by viruses, and

still others the result of allergy-like reactions to inanimate substances. The common cold causes more loss of time from work than any other single condition, yet it results in little serious disability.<sup>32</sup> Out of this complex of syndromes a few entities are gradually becoming more distinct. Acute, subacute, and chronic nasopharyngitis or sinusitis due to the pneumococcus or hemolytic streptococcus probably accounts for a large proportion of what is termed the common cold. A filtrable agent has been isolated from humans<sup>33</sup> which will produce colds in other humans and in chimpanzees. The virus can be propagated in Maitland's<sup>34</sup> tissue culture medium. Van Rooyen and Rhodes<sup>203</sup> state "there is every indication that Dochez's cold virus is a specific entity, and not merely a variant of any other virus likely to be met in the respiratory tract."

**PREVENTION AND CONTROL.**—This group of diseases, like influenza, pneumonia, measles, mumps and chickenpox, is spread through the medium of nasal secretions, and no method of proved value has been devised to eliminate the great hazard resulting from the interhuman traffic of respiratory secretions.

In a military organization, prompt *isolation* of one man coming down with a cold may avert a sudden spread of the infection and thereby lessen the severity of the epidemic even though the number of cases is not materially reduced. Attacks of minor respiratory infections occur about three times per person per year, suggesting that the *immunity* is short-lived.<sup>35</sup> This fact of evanescent immunity has been confirmed by experimentation with the cold virus.<sup>33</sup> *Vaccines* have not as yet been proved to be of value in preventing this common disease.

**Mumps.**—*Immunity* to mumps is usually permanent after one attack. Artificial immunity produced by the use of a vaccine is unknown. A degree of passive immunity can be obtained by the use of convalescent serum collected within one to three months of the clinical attack and administered as 5- to 15-cc. doses intramuscularly. A lyophilized preparation is under experimental study at this time.<sup>43</sup>

**Military Importance.**—Mumps is truly a disease of great military importance. It can be likened to a wolf in sheep's clothing. Emerson states, in his summary of communicable diseases, "in terms of sick wastage, and measured by the number

of days lost from military service on account of sickness, mumps was the most important disease in the A.E.F."<sup>36</sup> Over a million days were lost due to mumps alone. No deaths were attributed to mumps, but it was the third most important cause of noneffectiveness.

*Recent Advances in Knowledge of the Disease.*—Our knowledge concerning the nature of mumps has increased along certain lines since 1918. The researches of Johnson and Goodpasture<sup>37</sup> have definitely established the *virus* nature of epidemic parotitis. From an epidemiologic standpoint it seems established that *subclinical infections* and very mild attacks do occur in monkeys.<sup>38</sup> If true for humans, these factors might account for some of our difficulties in controlling this disease. At the same time it is felt by Gordon and Heeren<sup>39</sup> that mumps is less communicable than measles, chickenpox and pertussis but more so than scarlet fever and diphtheria. The attack rate among urban and rural troops is of striking importance, being 15 per cent for the former and 85 per cent for the latter at Camp Upton in 1918.<sup>40</sup> During the 1918 military outbreaks, Brooks felt that the *period of infectiousness* was "as long as the active lesions—that is, the swollen glands—persist."<sup>40</sup> The extensive studies of Wesselhoef<sup>41</sup> have shown that the average *incubation period* is eighteen days, and other studies<sup>42</sup> have shown that the period of infectiousness begins about four days prior to the glandular swelling. More recently Gordon and Heeren,<sup>39</sup> as a result of laboratory and field experience, have reached the conclusion that communicability rarely extends beyond the time when the swollen glands begin to recede.

**Yellow Fever.\***—Reed, Carroll, Agramonte and Lazear, as the United States Army Yellow Fever Commission, demonstrated conclusively that yellow fever is transmitted from man to man by the *Aedes aegypti* mosquito, that the causative agent is in the human blood during the first few days of illness, and that this agent is filtrable;<sup>44</sup> but at what a cost—the death of Lazear and near death of Carroll.

\* Further details on the tropical diseases have recently appeared in "Notes on the Treatment and Control of Certain Tropical Diseases," Circular Letter No. 56, Office of the Surgeon General, War Department. Reprinted in War Medicine, 1: 539-568 (July) 1941.

**PREVENTION AND CONTROL.**—The present conflict will take soldiers into areas infested by mosquitoes carrying the yellow fever virus, but it is comforting to know that a *vaccine* has been developed that will protect against this disease. Measures against *Aedes aegypti* were long considered the means of preventing the spread of yellow fever, but it has been learned that many other varieties of mosquitoes may transmit the disease. A probable reservoir is the monkey population of Africa and South America. These two epidemiologic facts place emphasis on the combined use of vaccine and anti-mosquito measures to control yellow fever.

The War Department has directed that all military personnel now stationed in the tropical regions of the Western Hemisphere, including Puerto Rico and Panama, be vaccinated against yellow fever.<sup>44</sup> The vaccine will also be given prior to departure to all personnel ordered to those regions.

Yellow fever vaccine must be given only to persons in good health. It should not be given concurrently with smallpox vaccine. Yellow fever vaccine may be given simultaneously with triple typhoid vaccine or tetanus toxoid.

Slight febrile reactions may occur in four to seven days, but they seldom interfere with routine duties. The resulting immunity may be lifelong, but if an epidemic occurs, another injection is given.<sup>45</sup>

#### DISEASES CAUSED BY BACTERIAL AGENTS

Certain of the bacterial diseases merit consideration in this discussion for different reasons. Typhoid fever and dysentery we have learned to prevent but not to cure. Pneumonia and meningococcal meningitis we have learned to cure but not to prevent. Diphtheria and scarlet fever we can both prevent and cure.

**Gastro-intestinal Diseases.**—Methods have been developed to prevent the occurrence of the important gastro-intestinal diseases. The present generation has been so thoroughly catechized with the principles of environmental sanitation that the once great epidemics of *typhoid fever* and *dysentery* have been reduced in importance to the realm of potential hazards. Man has become addicted to a bath-a-day principle and feels em-

barrassed if he cannot brush his teeth at least twice a day, and there is no question but that he is the better for it all. We not only think clean drinking water is a good thing, but we demand it. Pasteurized milk, exclusively, is used in the Army and by 85 per cent of the populations of the large cities; since raw milk can never be dependably safe, this best of foods should be boiled when pasteurization is not possible. Many other hygienic measures have originated as a result of experimentation in the field of communicable diseases and they are now the elements of common decency. The soldier of today will be better informed concerning these measures merely as a result of his bringing up and, unless great havoc is wrought, the diseases associated with environmental sanitation are likely to remain potentialities only. It would be folly, however, to slacken for an instant the rigid application of routine precautions against the gastrointestinal diseases.

**Pneumonia.**—TREATMENT.—The greatest advances in the field of pneumococcal infections have been in therapy. Reports appearing during the past two years on the efficacy of chemotherapy in a total of 1866 cases with 209 deaths, show a case fatality of 11.2 per cent. An analysis of these reports from the standpoint of type of drug and type of invading pneumococcus is shown in Table 2.

In the management of the individual case *sulfapyridine*, *sulfathiazole*, or, more recently, *sulfadiazine*<sup>60</sup> is given as soon as a clinical diagnosis has been established and the routine laboratory specimens have been collected. Three grams are given as the initial dose with 1 gm. every four hours until the temperature has remained normal for one or two days. As a rule 25 gm. is the average total dose given in three and a half or four days. Should signs of toxicity appear, the drug is discontinued (refer to "Chemotherapy of Infections"). If there is no improvement in the patient's condition after twenty-four hours, it is customary to administer type-specific *serum* in full doses intravenously. It is notable, however, that recent reports indicate no advantage to be gained by this procedure except in cases in which a drug-resistant pneumococcus is suspected.<sup>60, 61</sup>

Since the war of 1918 great advances have been made in our knowledge of pneumonia, and its role as a cause of dis-

TABLE 2

RESULTS OF TREATMENT OF PNEUMOCOCCAL PNEUMONIA WITH SULFAPYRIDINE AND SULFATHIAZOLE\*

Type	Cases		Deaths		Per Cent Fatality	
	Sulfa-pyridine	Sulfa-thiazole	Sulfa-pyridine	Sulfa-thiazole	Sulfa-pyridine	Sulfa-thiazole
1. . . . .	287	76	23	3	8.0	4.0
2. . . . .	97	21	8	3	8.2	14.3
3. . . . .	210	60	45	12	21.4	20.0
4. . . . .	61	24	4	2	6.6	8.3
5. . . . .	109	33	6	0	5.5	0
6. . . . .	47	13	2	3	4.3	23.1
7. . . . .	98	41	8	1	8.2	2.4
8. . . . .	99	30	7	2	7.1	6.7
9. . . . .	32	5	2	0	6.3	0
10. . . . .	12	4	1	0	8.3	0
11. . . . .	6	3	0	1	0	33.3
12. . . . .	23	4	2	0	8.7	0
13. . . . .	13	7	5	3	38.5	42.9
14. . . . .	53	16	9	1	17.0	6.3
15. . . . .	17	4	3	0	17.6	0
16. . . . .	15	4	5	0	33.3	0
17. . . . .	18	4	3	1	16.7	25.0
18. . . . .	30	8	6	1	20.0	12.5
19. . . . .	38	10	4	1	10.5	10.0
20. . . . .	13	5	3	1	23.1	20.0
21. . . . .	4	2	1	0	25.0	0
22. . . . .	7	5	2	1	28.6	20.0
23. . . . .	15	1	1	1	6.7	100.0
24. . . . .	7	2	1	0	14.3	0
25. . . . .	16	8	4	2	25.0	25.0
26. . . . .	6	1	0	0	0	0
27. . . . .	9	4	2	1	22.2	25.0
28. . . . .	11	4	2	1	18.2	25.0
29. . . . .	1	0	0	0	0	0
30. . . . .	2	2	0	1	0	50.0
31. . . . .	3	0	0	0	0	0
32. . . . .	0	0	0	0	0	0
Untyped. . . . .	104	2	8	0	7.7	0
Total. . . . .	1463	403	167	42	11.4	10.4

\* This table is based on a compilation of data reported by various authors since July, 1939.<sup>32-33</sup>



ability and of death has been comprehensively described by Heffron.<sup>45</sup> Our recognition of the protean nature of this disease makes us cautious of comparisons between the records of today and those of 1918. In general, as a result of the emergency produced by the pandemic of influenza, pneumonia was a symptom complex, a group of syndromes produced by several etiologic agents. The difficulty in separating the primary pneumonias from the secondary infections offered a great problem which, with the equipment available, was impossible of solution in the majority of instances. With the improvements in typing facilities and other methods of achieving an etiologic diagnosis this problem can be better met now than heretofore.

**PREVENTION.**—An important advance that is seriously needed in this field is a method of prevention. In this respect we are little better off than in 1918, even though studies of family contacts,<sup>46</sup> carriers, type-specific outbreaks<sup>47, 48</sup> and Felton's<sup>49</sup> work on the immunizing substance in the pneumococcus all seem to point toward this goal. Pneumococcal pneumonia affects members of the various age groups with markedly different frequency. Children and the aged are the ones most severely affected. In the period of life between ten and thirty years its incidence and fatality are at their lowest.<sup>45</sup> Since a high proportion of our armed forces are under thirty years of age a low incidence of primary pneumococcal pneumonia can be expected.

**Meningococcal Meningitis.**—There is no more startling evidence of the effect of modern chemotherapy on diseases of bacterial origin than that shown in the treatment of meningococcal infections. Meningococcal meningitis, always associated with military activities and so admirably characterized as a "crowd disease" by Greenwood,<sup>52</sup> has always been and may continue to be a problem of major magnitude even in the present conflict. Despite early diagnosis and the treatment then available it ranked fifth as a cause of death in the war of 1918. From the standpoint of the case fatality rate it ranked first (Table 1).

The occurrence of meningococcal meningitis is an alarming event and can truly be called a medical emergency. It calls for the greatest skill and resourcefulness not only in handling the outbreak if one occurs but also in treating the individual case.

In the past twenty years no outstanding advance has been made in its epidemiologic control. Mass carrier surveys in the past have proved disappointing<sup>63</sup> but when every facility for careful, unhurried research is available they may have epidemiological value. The technic must be exact to the last detail.<sup>64</sup> That the type of meningococcus has much to do with epidemicity has been pointed out by Branham.<sup>65</sup> The Group I-III is the cause of the acute, highly infectious condition; Group II is more likely to be found in chronic, possibly blood stream, infections.

**TREATMENT.**—Two important advances have been made in the treatment of meningococcal meningitis. As a result of the studies of Herrick<sup>65</sup> and Hoyne,<sup>67</sup> the use of *antimeningococcal serum intravenously* in large doses has become a routine procedure. Intraspinal administration of serum is now used only under exceptional circumstances. The second advance was made in 1937 when Schwenkter, Gelman and Long<sup>68</sup> showed the value of *sulfanilamide* in the treatment of meningococcal meningitis. Since the introduction of sulfanilamide, there have appeared reports of more than 1400 cases treated with chemotherapy alone, with a case fatality rate of less than 8 per cent. Table 3 indicates the relative effectiveness of different chemotherapeutic agents in the treatment of meningococcal meningitis.

TABLE 3

RESULTS OF TREATMENT OF 2747 CASES OF MENINGOCOCCAL MENINGITIS BY DIFFERENT METHODS

(Collected from the literature August, 1937, to June, 1941\*)

Method of Treatment	Cases	Deaths	Fatality, Per Cent
1. Sulfadiazine (alone)	13	1	7.6
2. Sulfathiazole (alone)	70	3	4.3
3. Sulfapyridine (alone)	588	25	3.9
4. Sulfanilamide and sulfapyridine (combined)	214	17	7.9
5. Sulfanilamide (alone)	588	66	11.2
6. Serum and sulfanilamide	165	20	12.1
7. Serum (alone)	1109	349	31.4
Total	2747	478	

\* The bibliographic references to this table will be supplied on request.

PREVENTION AND CONTROL.—At least three lines of investigation have each resulted in advances which, if used in conjunction with each other, might go far toward controlling outbreaks of this disease. The newer methods of *isolation and identification* of this organism from the nasopharynx, spinal fluid, and blood have greatly improved our yield of positive cases. We are rapidly gaining a more accurate idea of the prevalence of the organism in normal persons. These methods have also given us a better idea of the relation of the Group I-III organisms to outbreaks.<sup>65</sup> Another line of advance is the rapidly expanding fields of *air sterilization* with ultraviolet light; or possibly with aerosols. These researches may result in very useful and practical measures of controlling this disease.<sup>4, 21</sup> Finally the extraordinary results obtained by the various chemotherapeutic agents in the treatment of meningococcal meningitis (Table 3) may lead to useful measures for controlling its spread.<sup>69</sup>

In short the problem is actually something like this. A case of meningococcal meningitis occurs in a barracks of 100 men. The patient is isolated in the hospital. The organism is recovered and typed at once. The administration of sulfapyridine by the oral or intravenous route—or both—is commenced as soon as the organisms can be demonstrated in the spinal fluid. If no organisms are found but the spinal fluid is cloudy, and contains 500 or more white blood cells, all of the polymorphonuclear variety, and the spinal fluid sugar content is diminished, it is advisable to treat the patient for meningococcal meningitis until there is proof of another disease.

While this patient's treatment is progressing the following coincident preventive measures can be carried on in the barracks. Quarantine can be established, throat cultures made, ultraviolet lights installed, and sulfanilamide or sulfathiazole can be given to each soldier in a 2-gm. initial dose followed by 1 gm. a day thereafter. When the *carriers* have been identified, after two to three days of bacteriologic study, they should be allowed to remain in the barracks but should be given larger doses of the drug. There is evidence that carriers of either Group I-III or Group II organisms when intensively treated with sulfapyridine can be cured of the carrier condition.<sup>69</sup> In

his manner a combination of several procedures may effectively interrupt the infection chain in epidemic meningococcal meningitis.

**Diphtheria.**—It is not customary to vaccinate each soldier with diphtheria toxoid as he enters the Army. In this disease, as in scarlet fever, it has been found that at the age of twenty a high percentage of people show antitoxic immunity. The generous use of diphtheria toxoid among the contacts of a patient with diphtheria would be effective in averting a serious outbreak.<sup>70</sup>

The TREATMENT of the individual case is well standardized; early administration of large doses (20,000 to 100,000 units) of antitoxin will ordinarily be sufficient. In cases where there is any suspicion that the patient has diphtheria it is good medicine to give diphtheria antitoxin. Laboratory tests may be made later. Contacts are placed in isolation and inspected at least twice daily; antitoxin is given if there is any indication that it is needed; it is not given prophylactically.

**The Streptococcal Diseases.**—A Board for the Investigation and Control of Epidemic Diseases in the Army has been established and one of the commissions of this organization deals directly with those infections caused by the hemolytic streptococcus. This board is making rapid strides and has already taken steps of national scope to set up diagnostic grouping and typing stations in key cities. In this way the varieties of hemolytic streptococci recovered during outbreaks can be accurately identified. An accumulation of such specific etiologic information will aid greatly in the epidemiologic understanding of this important group of diseases and promote more rational methods of control.

**PREVENTION AND TREATMENT.**—At the present time *scarlet fever* is the only disease caused by the hemolytic streptococcus for which we have specific preventive measures. But the use of the scarlet fever toxin is not a routine procedure in the Army. We know from mass testings of urban populations that of persons reaching the age of twenty years nearly 85 per cent are immune to the erythrogenic toxin. For this reason it is recommended only to aid in the control of outbreaks of scarlet fever.<sup>70</sup>

For the very prevalent *tonsillitis*, *peritonsillar abscess*, *erysipelas*, *streptococcal pneumonia*, *wound infections*, and other primary or secondary streptococcal infections we have no specific agents of prevention. In view of the action of the sulfonamide group of drugs on the hemolytic streptococcus (Table 4), prompt use of any one of the various members of this group

TABLE 4

ACTIVITY OF SULFONAMIDE DRUGS AGAINST VARIOUS ORGANISMS\*

Infecting Organism	Sulfanilamide	Sulfapyridine	Sulfathiazole	Sulfadiazine
Streptococcus.....	+++	+++	+++	++
Clostridium perfringens (Clostridium welchii).....	+++	+++	—	—
Clostridium septicum (Vibrio septique).....	=	+	—	—
Clostridium oedematiens.....	0	0	—	—
Staphylococcus.....	=	+	++	+
Meningococcus and Gonococcus...	+++	++++	++	+++
Pneumococcus.....	=	+++	++	+++

++++ Very good and rapid effect

+++ Good and reliable effect

++ Good, but less than above

+ Slight effect

= Very slight effect

0 No effect

— No data available

\* Modified from Buttle, G. A. H.: Chemotherapy of Infected Wounds. *Lancet*, 1: 890-893 (May 11) 1940.

in treatment is indicated. In erysipelas the results are excellent. In tonsillar infections the action frequently averts the necessity for surgical drainage of a peritonsillar abscess. The results in the treatment of streptococcal pneumonia are good though not so dramatic as in the pneumococcal variety.

Many internists advocate the use of chemotherapy in conjunction with antitoxin for the treatment of scarlet fever. Much research with carefully controlled groups is still necessary before more convincing proof of the complication-reducing effect of chemotherapy in scarlet fever is obtained. Antitoxin in large doses (6000 to 8000 units) administered early in the course of

the disease has proved useful in effecting a favorable outcome.<sup>71</sup> The outlook for control and treatment of this large and important group of infections is far better than in the previous war.

**Wound Infections.**—Wound infections do not come directly within the province of this paper even though they do constitute one of the most important causes of disability. These problems will be dealt with in other parts of this symposium. However, certain problems concerning their bacteriology will justify emphasis at this point. Sweetser,<sup>72</sup> in an excellent review of the literature on war wounds both in this war and in that of 1918, has stressed the importance of the anaerobic organisms as causes of illness in the early stage of wound infections, but he emphasized the great importance of the hemolytic streptococcus as the "killer." Today we have two specific agents, antitoxin and chemotherapy, to combat these disease-producing agents. The compulsory vaccination of all soldiers with alum-precipitated tetanus toxoid has been an important advance in the prevention of tetanus.<sup>73</sup> This fact was well demonstrated in the reports of the evacuation of Dunkirk.<sup>73</sup> A reference to Table 4 shows the relative activity of the various sulfonamide drugs against certain selected organisms. The results are approximate and stem from both in vitro and in vivo studies.

#### SUMMARY

During the war of 1918, mobilization of large groups of men with varied environmental backgrounds initiated a chain of events which culminated in serious epidemics of disease. Since that time there have been many and varied lines of investigation, some of which have borne fruit of a type that will assist the medical officer of today who is carrying out his mission of *health for the soldier*. In this paper an attempt has been made to couple some of the reported experiences gained during the former war with some of the outstanding recent advances made in the control of the communicable diseases most commonly affecting military forces.

Up to the time of this writing the incidence of communicable disease in our mobilized forces has been minimal. All those concerned in bringing about this fine result have good reason to be

elated. While enjoying this elation they will not relax any part of their vigilance. They know only too well that preventive measures not kept at top efficiency permit disease to occur

When we are permitted in civil practice to apply the preventive knowledge we actually possess and continue to make it effective there will be a marked depletion noticeable in the wards of our hospitals for infectious diseases. There are indications that such an era is actually on its way.

Communicable disease and military medicine oppose one another at five points—civilian medicine stands in opposition to communicable disease at exactly the same five points:

1. Prevention. When this has failed—
2. Early and precise diagnosis.
3. Isolation.
4. Prompt and adequate treatment
5. Investigation and management of the resultant carrier and contact problem.

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## CARDIOVASCULAR DISEASE AND MILITARY MEDICINE\*

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### ETIOLOGY AND PREVALENCE OF CARDIOVASCULAR DISEASE IN THE BRITISH MILITARY FORCES OF THE NINETEENTH CENTURY

THE problem of cardiovascular disease and military medicine began to receive attention early in the nineteenth century.

Surgeon-Major W. E. Riordan, in an interesting monograph entitled "Heart Disease and Aneurism in the Army," published in 1878, states:

"Doctor Maclean, writing about diseases of the heart, in the Army Medical Report for 1867, says: 'I cannot pass from this subject without doing justice to the memory of a highly meritorious medical officer, the late Staff-Surgeon R. H. Hunter, formerly of the 2nd Queen's Royal Regiment. This officer was the first, as far as I know, to direct attention to the true cause of prevalence of diseases of the heart and great vessels in the army. . . .' Doctor Hunter thus expressed his views: 'Ever since I joined the 2nd Queen's at Colaba in 1831, I have been struck with the frequency of cardiac and aortic disease. At first I thought it might be connected with some morbid state of the blood which gave rise to purpura so frequent at that station; but it afterwards prevailed to an equal extent at Poona, where no such cause could be assigned; neither does it appear to be altogether connected with rheumatism, though certainly most frequently so, but whether or not rheumatism be the first link in the morbid chain, a more sufficient cause for hastening the progress I am convinced is the active duty the soldier under-

\* The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

goes whilst buttoned up in his accoutrements. These, by compressing the neck and chest, obstruct the circulation to such a degree as to excite the heart into inordinate action, and cause great hypertrophy in the strong and muscular, or dilatation in the weak and sickly. Again in the former, the natural resiliency of the aorta being overcome by the inordinate force of the circulation, that vessel yields, dilates, and finally gives way, giving rise to aneurism.' ”

Riordan then goes on to say: “Ever since this was written, these opinions as to the causation of heart affections and aneurisms seem to have prevailed among medical officers, and many figures and circumstances have from time to time been brought to bear on the subject in support of these views; yet with all the disease we have, there is not much hypertrophy met with in the army, while aneurisms of the aorta are of very frequent occurrence.

“As regards the amount of diseases of the circulatory system which occurs in the service, compared with what has been observed among the male civil population of the soldier's age, for obvious reasons it is not at all easy to arrive at just conclusions; but from statistics drawn up for the purpose, it may be stated that heart affections are about four or five times, and aneurisms say fifteen times more frequent among our troops. Inspector-General Lawson proved that deaths alone from aortic aneurisms were eleven times more numerous in the army; and we shall see hereafter that the deaths probably represent but a very small proportion of the disease.”

An outstanding contribution to the literature on the subject was the Alexander prize essay “The Etiology and Prevalence of Diseases of the Heart Among Soldiers” by A. B. R. Myers, Assistant-Surgeon, Coldstream Guards, published in 1870 in which he cites definite figures showing that diseases of the circulatory system were more prevalent in the Army than in civil life. In the year 1861 the death rate in the British Army is given as 8.36 per thousand, 0.9 per thousand being attributed to diseases of the circulatory system, while in the civilian population the death rate is given as 11 per thousand, 0.77 per thousand being attributed to circulatory diseases.

In analyzing deaths and invaliding due to diseases of the

circulatory system he showed that in the Home Services of the British Army, 1863 to 1867, 43 per cent of deaths attributed to the circulatory system resulted from aneurysm and 32 per cent from valvular heart disease, and that valvular heart disease was responsible for the invaliding of 38 per cent and aneurysm for only 2.6 per cent of those with circulatory disease.

He was of the opinion that mechanical obstruction to the circulation caused by the general constriction of the neck and chest by faulty clothing and accoutrements rather than syphilis accounted for the majority of aortic aneurysms in the Army.

Myers, comparing the Army with the Navy stated: "The navy, it might naturally be assumed, would show a greater death-rate from this cause than the army, owing to the abnormal strains frequently imposed on the sailor's heart by the extreme and sudden violent exertions which are incidental to his work.

"I was recently informed by an Inspector-General of the Navy that he had often observed intense excitement of the heart's action produced in young sailors by running aloft, manning the yards, etc., and that he had at times almost felt surprise at not having seen this end fatally. He added that many men were invalided for functional disease of the heart attributable, in his opinion, to the above."

Myers proved, however, by statistics that the Navy lost fewer men from diseases of the circulatory system than the Army. During the period 1860 to 1865 inclusive the Navy mortality was 0.66 and invaliding 3.44 per 1000, while during the same period the Army mortality was 0.9 and the invaliding was 5.26 per 1000.

#### "IRRITABLE HEART" IN AMERICAN CIVIL WAR TROOPS

Riordan cites the following interesting observations made during the American Civil War: "Doctor Henry Hartshorne, writing in 1864 on heart disease in the Army of the United States of America (Half-Yearly Abstract of Medical Sciences, vol. XL) remarks on what he calls muscular exhaustion of the heart, differing from ordinary palpitation; and after referring to dilatation and hypertrophy, says, 'Yet the majority of heart diseases under my observation were not cases of either

form of enlargement of the heart. . . . The symptoms were rapidity with comparative feebleness of pulse, while the patient was at rest; great acceleration of the heart's movements on the slightest exertion. An impulse in proportion to its acceleration was rather below than above the normal average force, and was sudden and short, not heaving. . . . These cases occurred in men who went through the privations of the Potomac campaign, and were anaemic, but when the anaemia was removed, the disability still remained. . . . The physical signs observed in the majority of these cases were as follows: no extension of dullness on percussion beyond the usual limits, and sometimes even less than natural; impulse without unusual force, and especially deficient relatively to its acceleration, having also a short although hardly a jerking movement, but quite different from the heaving movements of concentric hypertrophy, and not lifting the ear or stethoscope so much even as transient functional palpitation; sounds of the heart free from murmur in almost all cases. There was present, however, a comparative deficiency in duration and loudness in the first sound, and approximation to it in the character of the second sound.' "

Commenting on this Riordan writes: "Here then is a most admirable description, almost quite typical of the phenomena observed in the irritable or excitable heart found so frequently among our troops; but as our men are not subjected to the same privations as the Americans were, the explanation as to its causation will not hold good for us; neither will the supposable hypotheses apply in our case; so we must look elsewhere, for all these are of so incidental a nature that they may be left out of the calculation, as quite insufficient to account for the excessive amount of disease we have."

J. M. DaCosta in the United States Sanitary Commission Memoirs, published in 1867, writes: "Yet the mass of cardiac disorders is not organic, but functional. And of these again a very large proportion belong to the group which I have designated 'irritable hearts.' Elsewhere I have endeavored to depict the outlines of this curious malady; and I intend to publish a fuller narrative. To complete, however, this essay, and furnish a means of comparison, I will indicate very briefly the characters of the ailment. They are: great frequency of the action

of the heart, constantly recurring attacks of palpitation, and pain in the praecordial region. The very rapid action of the heart is associated with an extended, not forcible, but an abrupt or jerky impulse, sometimes of irregular rhythm, and with a short first sound, and a very distinct second sound. The disorder is an extremely obstinate one, and much exercise is impossible; the malady often exists when the general health is perfect. When present to a marked degree, it totally unfits the soldier for active duty—as much so as the worst organic disease.”

In keeping with his promise, DaCosta, in 1871, published his classic treatise “On Irritable Heart: A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences,” another outstanding contribution to the literature on the subject, in which he described clearly and in detail the disorder that has become known as “Soldier’s heart,” “effort syndrome,” or better, “neurocirculatory asthenia.”

During the period covered by these writings such conditions as aneurysm, valvular heart disease and neurocirculatory asthenia were the chief circulatory disorders encountered in the military forces. It is also interesting to note that there was a time when cardiovascular disease was more prevalent in the military forces than in civil life.

It is surprising that in view of this creditable beginning little worthy of comment concerning the subject appeared until the period of the World War (1914–1918).

#### CARDIOVASCULAR DISEASE IN DRAFT RECRUITS (1917–1918)

In “Physical Examination of the First Million Draft Recruits: Methods and Results,” Bulletin No. 11, War Department, Office of the Surgeon General, March, 1919, we note:

“The initial selective draft of 1917 upon the male population of military age to meet the emergencies of the world war gave the first opportunity in half a century to make a census of the physical constitution of the people of the United States. . . .

“The relative frequency of the different causes of rejection is a matter of perennial interest. From fairly complete returns as to rejections at local boards, at mobilization camps, and of



discharges on account of disability in camps, the Provost Marshal General concludes that during the first four months of mobilization about one-third of the men who were physically examined were rejected on physical grounds, and during the following eight months about one-fourth of such men were rejected. The Provost Marshal General's figures indicate that about 22 per cent of the rejections were caused by some mechanical defect in the organism, or rather some defect or disease that would interfere with its mechanical performance, such as defects in the bones and joints, flatfoot, and hernia. An additional 15 per cent were rejected because of imperfections of the sense organs and about 13 per cent for defects in the cardiovascular system. . . .

"The rejections at camps following the physical examination of the first million men reveal a different order. Thus, imperfections in the sense organs are the principal defects in this group, amounting to 21 per cent, and the mechanical defects take second place, being 20 per cent of all the rejections. Circulatory defects and diseases come next at 15.7 per cent. . . .

"The differences in percentage of rejections in the different groups at camp and in the figures of the Provost Marshal General are largely due to the circumstance that certain groups of defects or diseases were more readily detected and thoroughly eliminated by the local boards than were others. Consequently those conditions that were more difficult of detection appear in relatively greater frequency as causes of rejection at mobilization camps."

In discussing the heart it is stated: "The fifth in importance of the defects found at mobilization camps is the group of diseases and defects affecting the heart. Thus, during the period under consideration there was found 7,157 cases of valvular diseases of the heart and endocarditis; 181 cases of myocarditis and 526 cases of cardiac hypertrophy and cardiac dilatation; also 396 cases of cardiac arrhythmia and tachycardia, making a total of 8,260 defects ascribed to the heart. As we see, however, valvular diseases constituted the greatest group of defects found. They were found in 7.2 per thousand of the men examined. Of these cases, 5,429 were rejected, being about 76 per cent of all.

"The detection of valvular diseases of the heart and endocarditis is perhaps one of the most difficult of all of the determinations that have to be made by the methods available for the physical examiner. . . .

"It thus appears that of the drafted men, from whom those with clearly marked valvular diseases had been already eliminated, 7.2 per thousand were found to have valvular disease or endocarditis, and of these 0.75 per thousand to such an extent as to require rejection.

"A critique of the success of physical examinations is given by the admissions to sick report of the Army during 1917 for valvular diseases of the heart. There were 2,521 such admissions, also 1,059 discharges from the Army for disability on account of valvular heart diseases, and 10 deaths in the Army are ascribed to this cause. There were 40,661 days lost from valvular heart diseases, being 0.16 of a day per thousand days spent by the total number of men in the Army. . . .

"Cardiac hypertrophy and cardiac dilatation were relatively uncommon defects at mobilization camps. These defects were found in 0.5 of 1 per thousand. About two-thirds of the cases found were rejected. . . .

"Cardiac arrhythmia and tachycardia (irregular and rapid heart) are also functional disturbances which are found in camps in only 0.4 of 1 per thousand of the men examined. Of the cases found, however, more than 75 per cent were rejected."

#### CARDIAC DISORDERS THE RESULT OF WORLD WAR SERVICE

According to Thomas Lewis in his monograph "The Soldier's Heart and the Effort Syndrome," 1920, cardiovascular disease ranked second among medical ailments as a cause of discharge from the Army and Navy of Great Britain and pensioning up to the last day of May, 1918. Of 358,160 men invalided, wounds and injuries accounted for 138,699; "chest complaints" for 41,155 and "heart disease" for 36,569.

In an analysis of a group of 647 soldiers returned from the British Expeditionary Force with cardiac disorders (370 returned with D.A.H. [disordered action of the heart] and 277 returned with V.D.H. [valvular disease of the heart]) he found "effort syndrome" in 516 cases, aortic disease in 47, mitral

stenosis in 43, aortic disease with mitral stenosis in 16, enlargement of the heart in 10, other heart conditions in 5, and other diseases in 10.

As Paul D. White in War Medicine, March, 1941, comments: "Lewis elaborated what DaCosta had so well described in 1871 but did not discover the fundamental cause of neurocirculatory asthenia which for the most part still eludes research."

White continuing states: "My own experience with the American Expeditionary Force in France in 1917 and 1918 was much like that of Lewis except that I found fewer organic lesions. Of 24,254 men at United States Base Hospital 6, only 162 showed either chronic valvular disease or acute cardiac involvement; 116 men had the former condition and 46 the latter. There were in addition, 40 cases of acute pericarditis. In 9 cases a diagnosis of 'myocarditis' was made, and in 4, aortic aneurysm was present. There were 3 cases of auricular fibrillation and 4 of high grade heart block.

"After the World War there were (and there still remains) a moderate number of so-called cardiac cripples cared for in the United States Veterans Bureau Hospitals or receiving disability compensation. The majority had neurocirculatory asthenia, which often was erroneously and harmfully labeled 'myocarditis' before neurocirculatory asthenia was recognized as a just cause for disability. A tabulation which I made in 1921 with Doctor Francis H. McCrudden of data on 100 ex-soldiers sent to United States Public Health Service Hospital 36 with a diagnosis of valvular heart disease or myocarditis showed the following figures: neurocirculatory asthenia alone occurred in 45 of the men; aortic and mitral valvular disease in 16; mitral involvement alone (chiefly stenosis), in 7; aortic regurgitation alone in 6; other heart disease (including 1 instance of congenital and 1 of coronary disease) in 4, and miscellaneous conditions (not heart disease) in 22."

#### HEART AFFECTIONS IN THE UNITED STATES NAVY

What was the experience in the United States Navy? According to the annual reports of the Surgeon General, U. S. Navy, the recruiting statistics show that for the years 1917,

1918 and 1919 there was a total of 1,393,366 applicants examined by medical officers for the Naval Service of which 31,942 or 2.29 per cent, were rejected for "heart affections."

"Heart affections" were exceeded only by such defects as defective vision, underweight, flat feet, deformities and defective teeth. The only other cardiovascular condition listed as a principal cause of rejection was varicose veins. Aneurysm, arterial hypertension, congenital and other cardiovascular defects were apparently so few that they were listed under the miscellaneous group.

During this period 32,522 men were invalided from the Naval Service, 29.198 or 89.78 per cent for disease, of which 3254 or 11.14 per cent were invalided for the following cardiovascular disorders: chronic cardiac valvular disease, 1866; chronic endocarditis, 508; chronic myocarditis, 457; varix, 162; tachycardia, 104; general arteriosclerosis, 31; pericarditis, 20; aneurysm, 20; acute endocarditis, 15; hypertrophy of heart, 13; angina pectoris, 12; cardiac palpitation, 11; heart block, 10; chronic cardiac dilatation, 7; adherent pericarditis, 7; aortitis, 6; and acute myocarditis, 5.

In the same period there were 12,141 deaths, 7817 or 64.38 per cent from disease of which 164 or 2.10 per cent were attributed to the following cardiovascular conditions: chronic cardiac valvular disease, 32; acute cardiac dilatation, 29; acute endocarditis, 15; chronic myocarditis, 11; embolism, 11; angina pectoris, 11; aneurysm, 11; acute myocarditis, 9; chronic endocarditis, 8; apoplexy, 7; pericarditis, 6; thrombosis, 4; general arteriosclerosis, 3; fatty heart, 3; heart block, 2; aneurysm of heart, 1; and rupture of heart, 1. "Effort syndrome" or "neuro-circulatory asthenia" among naval personnel was undoubtedly included under various other disorders as the diagnostic title "effort syndrome" does not appear in the Navy nomenclature until 1924 when it was placed under diseases of the nervous system. But, as White remarks, "the classification is probably not even yet correct."

What is the situation at the present time in the Naval Service? The Surgeon General's annual report gives the annual death rate for 1939 as 2.10 per thousand in a Navy of 149,618 officers and men, of which only one tenth (0.23 per thousand)

of the deaths were attributed to diseases of the circulatory system. This is quite a contrast to the figures cited by Myers for the British Army in 1861 when the total death rate and deaths due to diseases of the circulatory system were four times as high. As previously mentioned, at that time there was a greater incidence of circulatory disease in the military forces than among civilians.

We also find a difference in the relative frequency of the causes of death and invaliding from circulatory disease as noted by Myers in 1870 and recorded from the experience in the American Expeditionary Force and British Army in the World War. For instance, the Surgeon General's report lists *coronary disease*, which was hardly mentioned previously, as the leading cause of death from circulatory disease in 1939 (0.15 of the 0.23 per thousand). It is interesting to note that in the Navy during the years 1924-1939, 135 deaths were recorded as due to coronary thrombosis. From 1924 to 1930 only four deaths were attributed to this condition, and during three of these years no deaths from this disorder were recorded. In 1931, six deaths were recorded, in 1932 fourteen, in 1933 ten, in 1934 twelve, in 1935 thirteen, in 1936 nineteen, in 1937 thirteen, in 1938 twenty-five and in 1939 nineteen. Since 1931 there has been a progressive downward trend in the deaths due to angina pectoris, acute cardiac dilatation and chronic myocarditis, and deaths previously reported as due to general arteriosclerosis have completely ceased. As the death rate per thousand for diseases of the circulatory system has not increased significantly during the past ten years we can infer that some deaths formerly listed under the above and possibly other diagnoses are now being diagnosed as coronary thrombosis.

In 1939 no deaths occurred from valvular heart disease, while aneurysm, which was one of the outstanding disabilities on earlier occasions, was the cause of only one death among approximately 150,000 officers and men of the United States Navy.

Of 10.37 men per thousand invalided from the United States Navy in 1939, only one fifteenth (0.70 per thousand) had circulatory diseases. Valvular heart disease ranked first (0.19 per thousand), arterial hypertension, another problem.

was second (0.17 per thousand), chronic myocarditis, was third (0.09 per thousand), coronary thrombosis was fourth (0.07 per thousand). "Effort syndrome" accounted for 0.08 admissions per thousand.

Thus it is clearly evident that, insofar as cardiovascular disease and military medicine are concerned, considerable progress has been accomplished, and it would appear justifiable to attribute this largely to the ability of medical officers in detecting cardiovascular defects in applicants for enlistment and candidates for appointment; to the protection of naval personnel from such causes of these disorders as rheumatism and syphilis; and to the early recognition of cardiovascular disease in the service itself.

The progress made should be maintained and further study given such problems as coronary disease, arterial hypertension and neurocirculatory asthenia in order to prevent entry into the service of men whose disabilities will be aggravated by service conditions and result in the invaliding and turning back into civil life, during and after a war, of an unduly large number of cardiovascular cripples.

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## MEDICAL ABDOMINAL EMERGENCIES\*

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A NAVAL Surgeon's conception of the subject, "Medical Emergencies" may prove disquieting to his medical colleague. In extenuation for stressing the surgical background so strongly, the author prays that the status of the National Emergency and wartime limitations be kept in mind. The scope of this paper will be restricted to emergencies of the abdomen, to the major and common lesions met with under wartime conditions in the Navy.

War today differs from previous conflicts in that action now approaches barbarous total warfare. Stationary war, trenches, orthodox battlegrounds, gallantry and respect for women and children are replaced by blitzkrieg on land, at sea and in the air. Terror is on the march. Mechanized forces sustained by perfection in aircraft wage merciless and ruthless cruelty. Every American should be for national defense, which means that every doctor must find his stride in his work and must support with all his strength and special ability the defenders of America. An adjustment from the orderly routine of peacetime to a dynamic new order must be made if the glorious traditions and institutions of America are to be maintained.

### HOW NAVAL MEDICINE DIFFERS FROM CIVILIAN PRACTICE

Naval war conditions present striking variations from the civilian medical background of peacetime. Naval medicine differs in the type of doctor, patient and lesion.

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**The Doctor.**—The reserve or regular officer of the Naval Medical Corps may be a member of a well-balanced medical unit with equipment and facilities equal or even superior to those he enjoyed during his civilian training. Or he may be alone on independent duty charged with medical responsibilities as extraordinary and striking as those found by the general practitioner on isolated stations in the pioneer days.

Medical emergencies for the staff of the balanced Naval medical unit present no greater problems than found at the civilian medical center. A benevolent government provides amply the finest equipment and spares no expense to insure adequate medical care for her patriotic sons. Immediately available are diagnostic centers, hospital facilities, excellent nursing, and efficient medical and surgical attention.

The doctor on independent duty faces moments of grave responsibility. Independent judgment, decision and action must replace dependence upon hospital or ready consultation usually available in civil practice. Despite limited diagnostic facilities aboard ship the practical well-balanced medical officer will find them ample for the establishment of a safe working diagnosis and for the institution of proper treatment.

**The Patient.**—The most striking variation from civil life is found in the patient—the sick sailor or marine. Here indeed is medical regimentation but stripped of all evils associated with socialized medicine. The man knows that his government has provided a medical officer to care for his needs. He accepts without hesitation the fact that the doctor has been selected for his post, that his professional qualifications have been checked and approved by high Naval medical authorities. Rank and name matter little; the Navy man turns with full confidence to his doctor.

The relationship between medical officer and sick sailor or marine is cordially fine. The doctor feels his sense of responsibility, is truly inspired and stimulated by the knowledge that he represents a medical trust, occupies a medical post, that he must not, dare not, fail. The very fact that the man presenting himself at sick call has no choice of doctor or surgeon inspires a fine sense of responsive trust that stimulates and calls forth his best professional ability. There is no consideration of fee

or expense, the seaman simply rates every medical aid. The driving thought is to correct the man's disability, to restore him to duty, back to the guns, at the earliest moment.

**The Lesion.**—Another important variable is the physical standard of the men in service. Carefully selected by high Naval physical standards, the seaman or marine is physically superior to the civilian sick. He is young and strong and chronic organic disease is usually absent. In the older grades visceral disease and damage develop, to be sure, but upon a basic foundation of health that speaks well for the physical culture of the service. Good food, hard exercise, work and recreation repel ravages of disease common to nonmilitary men in civilian occupational activity.

So we have a traditional background of Naval regimented medicine: A carefully selected doctor serving a patient who is a brother in arms. Doctor and patient patriotically serving the same good cause. No fee, no expense to be considered, a mutual desire, urge, for correct diagnosis, efficient treatment and early care that their cause may be best served.

#### DIAGNOSIS OF ABDOMINAL EMERGENCIES

Medical lesions, emergencies, of the abdomen, what are they? To salute our medical colleague we must consider the functional disorders, the belly aches and usually self-correcting disturbances, which are the lot of all men. But always loom the potentialities of organic disease—cholecystitis with or without stones, the commonest organic disease of the digestive tract; the perforated peptic ulcer; hematemesis from an eroded artery; mesenteric hemorrhage and occlusion; deep abscess, hepatic and subdiaphragmatic; intestinal obstruction, peritonitis, intussusception, volvulus, tumor or hernia; appendicitis; genito-urinary disease; splenic disorders; pancreatitis; malignant lesions; and concealed internal injuries. Here indeed is surgical pathology, with the need for judgment, decision and action.

Homely advice—a dose of salts or a bit of soda will usually suffice for the functional disorder. General diseases and reactions that produce abdominal crises must be considered: hypertension; failing heart; pulmonary tuberculosis; hyperthyroid-

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set up reflex phenomena that will simulate disease localized beneath the diaphragm.

Abdominal pain may be complained of as sharp, dull, agonizing, cramplike, radiating, diffuse or localized. The patient's tolerance for pain must be considered; contrast the low threshold for pain of the young homesick sailor with the stoicism of the salty veteran of the older grades.

The youngest resident knows the classical pain of gall and kidney stone colic, but matured is he who rationalizes the referred pain of the trapezius ridge as phrenic nerve irritation produced by inflammation of the central diaphragm secondary to pus from empyema of the gallbladder, a perforated gastric ulcer or subphrenic abscess. Who differentiates the sharply painful ulcer of the fixed colon from the tolerable pain of ulcer of the ileum. Who is alert to the possibility that marginal inflammation of the diaphragm has irritated the lower six intercostal nerves with resulting referred pain to loin and flank. Who differentiates pain from the parietal peritoneum as being direct and not referred, in contrast to the pain from inflammation of the diaphragm. A great master once said, "Clinical acumen rests with the possession of no mysterious sixth sense but upon a thorough grounding in fundamentals."

#### PATHOGENESIS

The abdomen is a mighty cavity with less skeletal support than any portion of the body. Here is generated heat, energy and strength. Vital organs of digestion, absorption and excretion, the genito-urinary mechanism, main arterial, venous and lymph trunks, are hidden deeply away. Bounded above by the diaphragm which reaches high into the thorax, and by the fourth rib interspace, and below by the bony pelvis, the abdomen is truly a bag, a belly of dynamic force and power. Nature cares little for belly appearance—for pendulous fat and ugly curves—provided healthy functions are maintained. Disturbance of physiology will produce functional disorders which if not corrected lead to organic disease and associated visceral damage.

Navy conditions afloat under war conditions become severe at times. Submarine and aviation duty, landing parties, special sea details in the tropical and frigid zones entail hardships cer-

ism and hypothyroidism; pernicious anemia; arthritis of the spine; the acute intestinal infections and dysenteries; sulfanilamide reactions; overindulgence in food, liquor, coffee and tobacco; and the rare acute abdominal allergic manifestations. Surgical judgment is exercised in the above only for exclusion and differential diagnosis.

Abdominal organic disease may not always require operative surgery but surgical discretion and judgment should always be employed. The abdominal emergency demands an early safe working diagnosis, a careful differentiation of functional from organic disease. To accomplish this diagnosis the doctor should possess a practical knowledge of fundamentals covering the mechanism of abdominal function, the distress signals of pain, the anatomical watersheds and basins and the phenomenon of peritoneal irritation. There are three major processes of alimentation, namely, secretion, absorption and excretion. A major disturbance of one process usually upsets the other two and the body economy may become seriously affected. It has been said that we eat with our small intestine and drink with our colon. Amazing insults and dietetic abuses are patiently tolerated by stomach and digestive tract. Usually alcoholic indulgence offends less than intemperance in food, coffee and tobacco.

**Significance of Abdominal Pain.**—Presented with medical emergency, a good doctor observes one constant factor—abdominal pain. No other symptom offers better evidence upon which to base an interpretation and diagnosis than the recognized type of pain, somatic or visceral, of abdominal disease. The structures intimate to the parietal peritoneum are rich in cerebrospinal nerve distribution and resent with pain responses the irritation produced by inflammation and trauma. This is in sharp contrast to the sympathetic mechanism of the almost insensitive abdominal viscera. Pain will occur during increased tension or traction on the hollow organs but no painful sensation follows the application of heat or cold, or the cutting or clamping of the gut. It is important to keep in mind the thoracic course of the abdominal nerves, especially the phrenic, vagus and splanchnic nerves, for disease of the ribs, spine, pleura, lungs, heart or mediastinum may, by irritating these nerves,

**Constipation.**—Fecal impaction is found low in the colon. A cleansing enema will clear many suspected emergencies. Do not upset the entire gastro-intestinal tract by whipping it with purgatives.

**Gastro-mesenteric Ileus.**—Enormous dilatation of the stomach and proximal duodenum is a prominent feature. The etiology is often obscure, but the condition usually has a sudden onset of neurogenic origin. Treatment consists of keeping the patient in a prone position, and gastric lavage. Recovery is rapid and intubation or surgery is not necessary.

**Intestinal Obstruction.**—The cardinal symptoms are colicky pain, regurgitant vomiting, absolute constipation and progressive distention. Be alert for prompt recognition of strangulation, a surgical emergency that will not tolerate any delay for intubation. Miller-Abbott tubing or Wangensteen siphonage. Immediate surgery is also indicated in mesenteric occlusion, intussusception, volvulus, and internal and external hernia when the severity of peritoneal irritation rapidly progresses, temperature, pulse and respiration rise, leukocytosis increases and the patient appears gravely ill.

In postoperative ileus due to peritonitis or recent adhesion, try intubation. With gastric siphonage established, there is no need for haste. Water and chemical balance may be reestablished and the patient made a good surgical risk while waiting the results of expectant treatment.

**Paralytic Ileus.**—The rational and only uniformly successful procedure is decompression with Miller-Abbott tube or Wangensteen siphonage. Surgery is not necessary.

**Hematemesis.**—Bleeding from peptic ulcer is rarely immediately fatal but if clinical estimation of blood loss shows severe hemorrhage and indicates an eroded artery, the case should be considered a surgical emergency. Rational management consists of blood transfusion before and during operation—before, if long transfer is to be made—with simple excision of bleeding ulcer or a partial gastric resection.

**Perforated Peptic Ulcer.**—Bear in mind that your ship's complement includes many men of ulcer age, that perforation often occurs suddenly without warning and that a good ulcer history is seldom given by the patient before the perforation.



tainly abnormal and unnatural. The ship is darkened and stripped of all loose gear; ventilation is impaired; the weather may be hot, cold or foul. Water is ample and good but food is restricted in variety, preparation and serving. Men become hard and carry on. Intestinal fortitude literally is strongly developed although alimentation becomes severely stressed. Abdominal emergencies arise.

#### TREATMENT OF ABDOMINAL EMERGENCIES

**Fatigue.**—The medical officer will be on guard for fatigue and heat exhaustion. Abdominal pain and cramps may prove very puzzling and deceptive. Rest, salt tablets and sugar will give prompt relief.

**Acute Abdominal Allergy.**—An allergic reaction may follow the taking of certain foods or drugs, or the administration of serums and pollen extracts. Any lesion of the gastrointestinal tract may be simulated. Basically there occurs an edema of the mucous membrane with spasm of the smooth muscle. Pain may become severe and cramplike but usually few positive physical findings are present. The examiner will keep in mind the possibility of co-existing surgical pathologic change and, if definite indication of peritoneal irritation is noted, it is safer to adhere to surgical principles of diagnosis and treatment regardless of the fact that allergy may mask or dominate the picture.

**Migraine.**—Beware of the repeater at sick call who complains of headache, nausea, vomiting, prostration and severe abdominal pain. Careful history will establish the absence of indigestion between headaches and exclude the possibility of surgical abdominal disease.

**Abdominal Distention.**—Determine the causative factors: excessive intraperitoneal fat, flatus, fluids or feces.

**Intestinal Gases.**—In the presence of shock and major emergency, keep in mind the rapid enormous gas distention associated with mesenteric thrombosis. Prognosis is guarded, probably unfavorable, even with early surgery.

**Intraperitoneal Fluids.**—Consider hemorrhage, septic pus, malignant peritonitis, bile peritonitis, tuberculosis, cirrhosis, Bright's disease, cardiac disorders, water imbalance and hypoproteinemia.

stools. As Dr. J. B. Hartzell<sup>1</sup> so well states: "Make painstaking and purposeful examination. A negative examination does not rule out malignancy. A negative digital or proctoscopic examination may mean a lesion higher up in colon. A negative biopsy may mean that the section has not been taken from the proper area . . . an inadequate or incomplete diagnostic study is worse than no diagnostic study at all. Remember that the easier it is to make the diagnosis of carcinoma of colon, the less the possibility of halting the fatal progress of the disease."

**Acute Appendicitis.**—Every Naval medical officer must be able to diagnose appendicitis and to institute operative treatment. The age incidence for appendicitis is known to be practically unlimited: it is very common in the young and active age of our Navy. Many Navy recruits have had untreated attacks before entering the service. Ship life, ample food—the best most of them have ever enjoyed—plus sturdy abdominal exercise in the performance of ship's work may perhaps prove too heavy traffic for an appendix previously scarred. The seaman bearing such a background becomes an emergency within the first few months of his Naval career.

It will be recalled that the appendix, like the colon, concentrates intestinal contents, secretes mucus and evacuates residue. Scarring, fibrosis and blocking of the residue may narrow the lumen of the appendix to the extent that evacuation is impaired, fecalith develops and complete obstruction follows. The appendix is strangulated, necrosis rapidly ensues and surgical delay will prove very serious. Should perforation and abscess develop, we believe operation to be yet immediately indicated. Removal of the often offending nidus, the fecalith, now free in the pus cavity, will permit resolution of the abscess. We have never failed to remove the appendix and believe that appendectomy, gently and properly performed preferably under local, procaine anesthesia, is always indicated once the diagnosis of appendicitis is established.

**Intraperitoneal Injury.**—Bombardments, torpedoes and depth charges may cause rupture of the colon and major retroperitoneal hemorrhage without apparent abdominal injury. Concussion and secondary blows from loose gear hurled about

Here knowledge of the abdominal watersheds and basins is of great clinical value. The ulcer lava follows the transverse colon and mesocolon through the supracolic basin to reach the right infracolic basin where the appendix bathed in the pool of acid leakage may give rise to a condition simulating acute appendicitis and mask the major lesion above. Some degree of shock, right abdominal pain and tenderness, pain of progressing peritoneal irritation from the acid leakage that keeps the patient writhing, and rapidly progressing boardlike abdominal rigidity should clear the clinical picture. Immediate surgery is indicated, with simple closure of the perforation and incisional wound without drainage. Prognosis is favorable if the perforation is simply closed during the first day.

**Meckel's Diverticulum.**—It is estimated that in about 2 per cent of births remains of the vitello-intestinal duct and of the artery to the yolk sac persist. The condition may simulate acute appendicitis, or produce intussusception and chronic or acute ileus. The site at the distal ileum should be checked when appendiceal gross pathology appears to be less than the clinical picture of appendicitis suggested.

**Cholecystitis with and without Stones.**—If a good surgical team and facilities are available, cholecystectomy is indicated in acute disease of the gallbladder. However, aboard ship, if limited surgical facilities exist, expectant treatment may be carried out. Empyema, even perforation, usually becomes walled off by protective adhesions and subsidence of the attack may be expected. Referred pain to the trapezius ridge is a warning of spreading pus to the phrenic zone of the diaphragm.

**Carcinoma of the Gastro-intestinal Tract.**—Cancers of the stomach and large bowel are usually slow of growth and late to metastasize, hence early diagnosis is all important. Cancer is listed among abdominal emergencies in order to stress the clinical urgency of careful check-up of early suspicious signs and symptoms of gastro-intestinal malignancy. Beware of your petty and commissioned officers who attain middle age with excellent digestion, then for the first time complain of indigestion. Be alert to changing bowel habits, constipation, vague abdominal discomfort and tenderness; note the presence of asthenia, unexplained weakness and anemia, blood or tarry

stools. As Dr. J. B. Hartzell<sup>1</sup> so well states: "Make painstaking and purposeful examination. A negative examination does not rule out malignancy. A negative digital or proctoscopic examination may mean a lesion higher up in colon. A negative biopsy may mean that the section has not been taken from the proper area . . . an inadequate or incomplete diagnostic study is worse than no diagnostic study at all. Remember that the easier it is to make the diagnosis of carcinoma of colon, the less the possibility of halting the fatal progress of the disease."

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**Intraperitoneal Injury.**—Bombardments, torpedoes and depth charges may cause rupture of the colon and major retroperitoneal hemorrhage without apparent abdominal injury. Concussion and secondary blows from loose gear hurled about

by explosive effects of near hits produce bizarre wounds and concealed injuries.

Surgeon L. R. Broster,<sup>2</sup> of London, guest speaker at the American Surgical Association meeting, April 29, 1941, reported that in the present European conflict the mortality from abdominal wounds is high; he estimated that about 2 per cent of all wounds are abdominal. He stated: "Multiplicity characterizes the wounds and damages sustained from air-bombardments. The severity of the concomitant injuries renders the prognosis of many an abdominal case hopeless. Some of those injured in the abdomen also suffer from burns of the body or limbs. These complications may be encountered in ships, where the prognosis obviously becomes very grave. The local application of sulfanilamide powder to the abdominal wound will prevent the infection of the latter, and the introduction of sulfanilamide in saline into the peritoneal cavity and possibly the application of the powder to the sites of injury or repair may improve the prognosis."

Intraperitoneal injury is indicated by pain, vomiting, persistent shock and signs of internal hemorrhage or leakage of visceral fluids, dyspnea, rapid pulse, pallor, shoulder and trapezius ridge pain, hiccough, leukocytosis and shifting liver and flank dullness. However, there is no sign or combination of signs sufficiently constant to form a basis for a safe diagnosis or estimation of the extent of abdominal injury. Exploration is the only definite means for diagnosis.

#### CONCLUSION

The surgical aspect of most of the major medical emergencies of the abdomen is strongly stressed. Naval war conditions demand professional ability tuned to surgical judgment, decision and action. Hidden talent in operative surgery abounds. Young doctors must be encouraged and trained in traumatic surgery, in common sense, and in practical management of battle casualties and disabilities.

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## MILITARY OPHTHALMOLOGY\*

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RECOURSE in settling disputes is still to brute force—to killing and maiming of peoples by their adversaries. Although settling disputes at the council table is a grand ideal it is indeed dubious whether war will become a vanishing fraction in human affairs, so long as an abyss exists between international and intranational morality. Since wars are almost continuously present on this earth the combatants must look to the military surgeon in quelling the hurts and making the repairs that life can still exist with the minimum of pain and inconvenience. The military surgeon gives the most of his medical skill not only to those of his own forces but to his adversaries as well.

### HISTORICAL DEVELOPMENT

Since the dawn of time man has fought, and in the interchange of blows the eye has sustained the effects of physical violence. At first it was a hand-to-hand encounter and later recourse was had to fighting with club against club and with this new weapon man discovered visors and shields for protection. Now we fight with greater refinement of cruelty and invade domains not normal as the habitat of man such as the sea, beneath the sea, and the air, and with this there is greater force behind the blow. In invading these domains there is an ever-increasing dependency upon vision. Camouflage and attack at night are done to evade the sharp scrutiny of the eye, and indeed good vision is a requisite for our fighting man today.

\* The opinions and assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

A study of eye injuries during the American Revolution of 1776 and the War of 1812 reveals nothing more serious than burns of the eyelids and eye from the flashings of powder from old-fashioned flintlock muskets or from the bits of flint itself. At Bunker Hill our soldiers were ordered by Colonel William Prescott "not to fire until you can see the whites of their eyes." This is the first instance of a stated visual acuity requirement in our armed services. Presumably they could not have been too myopic, otherwise they would have been at bayonet range.

In the history of our art there are but two kinds of ophthalmology, viz., that before and that after the invention of the *ophthalmoscope*. We might say that ophthalmology as a specialty had its beginning with the leadership of the three great masters, von Graefe, Donders and Helmholtz.

Hermann von Helmholtz (1821-1894), the inventor of the ophthalmoscope (1850), and Frans Cornelius Donders (1818-1889), known for his great work, "The Anomalies of Refraction and Accommodation," were military surgeons. Helmholtz served in the Prussian Army, and Donders in the Army of the Netherlands. Albrecht von Graefe (1828-1870), the creator of modern eye surgery, though not a military surgeon, was the son of Surgeon General Carl Ferdinand von Graefe. Military medicine in its broad sense has had an intimate connection with modern ophthalmology as it has developed since the American Civil War.

The noteworthy point of the Civil War of 1860-1865, from an ophthalmic standpoint, was the frequent occurrence of sympathetic ophthalmia. Many eyes were enucleated, but despite this operation sympathetic inflammation followed because the operation was done too late or too dirtily.

In the U. S. Navy (created by Act of April 30, 1798) visual fitness as well as general physical fitness was determined solely by the ship's surgeon from 1798 to 1871. In 1871 Dr. A. L. Gihon,<sup>1</sup> a Medical Inspector in the U. S. Navy, was so impressed with the need of physical standards that he published a book, "Practical Suggestions in Naval Hygiene," and advised Naval Surgeons to use the therein quoted requirements as a basis for accepting Naval and Marine recruits. He clearly saw that to guard against disease in the Military was to exclude its en-

trance. He was the first surgeon in the Navy to prescribe a systematic eye examination; to quote: "Examine the eyelids and eyes, closing and opening them to observe the motions of the iris. Test the eye sight by requiring the applicant to read test types." From his writings he was aware of the Argyll-Robertson pupil described first in 1869, and he wanted to preclude the entrance of men with this pathognomonic sign into the U. S. Naval and U. S. Marine Corps service.

In 1886 medical officers were instructed to use the Snellen Notation (1862) for visual acuity, and to use the Holmgren yarns (1874) for testing color vision. Detailed instructions were given for color testing.

#### MODERN VISUAL REQUIREMENTS OF THE U. S. NAVY AND U. S. MARINE CORPS

As time went on it was found necessary to have minimal requirements of vision and, since 1906, a minimum of 15/20 (20/30 or 6/9) vision on Snellen's test chart, unaccompanied by other ocular defects, has been necessary for original enlistment in the U. S. Navy and U. S. Marine Corps. A candidate for the U. S. Naval Academy must have 20/20 vision in each eye and have no evidence of myopia or myopic astigmatism as determined under 4 per cent homatropine cycloplegia. Hayden and Goss<sup>2</sup> have definitely proved that a reserve of approximately 1 diopter of hyperopia for entrance to the U. S. Naval Academy is necessary to preclude the development of myopia during a young man's career as a midshipman. A midshipman with only 0.50 diopter of hyperopic reserve upon entering stands no better than an even chance of not developing myopia while at the Academy. For commission in the Staff Corps (Medical, Dental, Supply, Civil Engineer, and Chaplain Corps) a minimum of 12/20 (20/35) Snellen visual acuity in each eye is required. Aside from defective visual acuity, no heterotropia, or disease of the fundus, media or eye adnexa is permissible for admission to any branch of the U. S. Naval Service. Some ophthalmologists might regard these visual acuity requirements as too rigid, but experiences gained from the World War of 1918, which will subsequently be dealt with, will substantiate the need for high standards of vision.



*Color perception* is carefully determined for entrance into the service. The color charts used are the pseudo-isochromatic plates made by the American Optical Company. No red-green color insufficiency is acceptable in the U. S. Navy and U. S. Marine Corps.

**Causes for Rejection of Applicants.**—So intent is the U. S. Navy and U. S. Marine Corps upon accepting only physical assets and not physical liabilities that U. S. Naval Medical Officers are stationed at the recruiting stations throughout the States. The medical officer at the recruiting station is usually not an ophthalmologist. Entrance into the U. S. Navy and U. S. Marine Corps is wholly voluntary and the figures given in Table 1, showing the number of applicants rejected for eye defects during 1939–1940 inclusive,<sup>3</sup> might be of interest to an ophthalmologist:

TABLE 1

REJECTIONS FOR EYE DEFECTS IN EXAMINATIONS FOR THE U. S. NAVY AND U. S. MARINE CORPS, 1939–1940 INCLUSIVE

	Calendar Year 1939		Calendar Year 1940	
	Navy	Marine	Navy	Marine
Total number examined for original enlistment. . . . .	96,325	28,053	154,119	51,455
Total rejections, all causes.	58,417	19,013	74,519	26,819
Ocular rejections:				
1. Red-green color insufficiency	3,238	982	5,273	1,993
2. Errors of refraction. .	8,679	3,285	12,767	5,063
3. All other eye defects	569	145	585	314

A rough estimate shows about 2.5 per cent of all applicants to have red-green color insufficiency. About 10 per cent have errors of refraction and cannot meet the 15/20 (20/30) Snellen minimum visual acuity requirement. It is obvious to any ophthalmologist that many of the rejections labeled "errors of refraction" may well be found to be optic atrophy, macular scarring, etc., if given close study. Readily detectable eye defects caused rejection of 899, or 0.25 per cent, of the applicants in 1940. These defects were in the main:

- |                   |                            |
|-------------------|----------------------------|
| 1. Strabismus     | 7. Argyll-Robertson pupils |
| 2. Blepharitis    | 8. Ulcer cornea            |
| 3. Ptosis eyelid  | 9. Choroiditis             |
| 4. Opacity cornea | 10. Dacryocystitis         |
| 5. Cataract       | 11. Trachoma—5 cases       |
| 6. Glaucoma       | 12. Nystagmus              |

Of those who applied and were rejected one had an artificial eye, and one patriotic enthusiast who was binocularly blind volunteered his services to the U. S. Navy.

To recapitulate, about 50 per cent of all applicants are rejected physically by the U. S. Navy and U. S. Marine Corps, and about 12 per cent of this total are ocularly unfit.

An important difference between military and civil ophthalmologic practice arises in the fact that, in addition to passing a rigorous physical examination prior to entrance into the military service, the subjects are drawn from an age which fails to embrace the many congenital and ocular maladies met with in youth and rules out also the ocular changes associated with advancing years.

There are certain conditions which are almost wholly within the military sphere, or at least are more prevalent in military ophthalmology, concerning which the civilian ophthalmologist who enters military service must refresh his knowledge.

#### EFFECTS OF THE POISONOUS GASES

**The Vesicants: Mustard Gas.**—Mustard gas (dichloro-diethylsulfide) was so called first by the British because of its characteristic smell. The effect on the eye is only one of its manifold actions and the ophthalmologist is called to treat such cases usually in conjunction with the surgeon. It produces a redness and swelling of the eyelids and is often accompanied by the formation of bullae on the lids. Its action involves chiefly that part of the eye encompassed in the palpebral fissure. There is a varying degree of conjunctival chemosis and also corneal lesions of varying severity, from slight roughening of the corneal epithelium to ulceration of the cornea. There is marked photophobia, lacrimation, and blepharospasm. Roughly, 75 per cent of the cases in the last war were considered mild and were completely relieved within two to three weeks. Cases.

however, can be severe and may require three to four months for cure. Seven cases of blindness from mustard gas are reported<sup>4</sup> in the American Expeditionary Forces. Many exposures that resulted in death from the general effect of the gas per se would have caused severe ocular lesions had the patients lived.

In treating these cases one must *never bandage* the eyes. The conjunctival sac should be washed with 1 per cent sodium bicarbonate every two or three hours. Dark glasses are given for the photophobia. To prevent gluing of the lids a few drops of sterile petrolatum may be instilled and atropine is used when there is corneal involvement. Warthin<sup>5</sup> recommended dichloramine-T, 0.5 per cent in chlorcosane, to prevent both infection and gluing of the lids.

It might be said that, with mustard gas involvement of the eye, the danger of symblepharon as a sequel is almost nil.

**The Lacrimators: Chloracetophenone and Brombenzocyanide.**—These gases cause extreme lacrimation and so much pain that useful vision becomes impossible. No permanent eye damage is done and irrigation with 1 per cent sodium bicarbonate suffices.

In 1918 there were 1421 admissions for injuries incurred by poison gas in the U. S. Navy and U. S. Marine Corps of an average strength of 503,792. Sick days from poisonous gases in the year of 1918 amounted to 73,445.<sup>3</sup> Many of these sick days, however, were the result of the involvement of poisonous gases of parts of the body other than the eyes.

#### EFFECTS OF ALTITUDE ON OCULAR FUNCTION

Wilmier and Berens<sup>6</sup> in 1918 made a series of studies of ocular function incident to a simulated altitude of 20,000 feet. These studies were made in a decompression chamber, using the rebreathing apparatus. The effects are due to a deprivation of oxygen or anoxia. Atmospheric air at sea level pressure and under standard conditions exerts a pressure of 760 mm. of mercury. Oxygen constitutes 20.96 per cent of air and therefore its partial pressure at sea level is  $760 \times 0.2096$  or 159 mm. of mercury.

One fact that must be remembered is that the percentage

composition of air remains constant up to an altitude of at least 72,000 feet, as determined by Stevens<sup>7</sup> a few years ago. It is evident, then, that the partial pressures of atmospheric constituents will decrease in the same proportion as does the total pressure. At one-half atmosphere, or 18,000 feet, the partial pressure of oxygen equals  $380 \times 0.2096$  or 79.5 mm. of mercury. It can be dogmatically stated here that signs of anoxia become clinically apparent at 12,000 feet during rapid ascent, until at 25,000 feet altitude death may occur in twenty to twenty-five minutes. Duration of exposure is obviously most important in developing anoxic symptoms. When the partial pressure of alveolar oxygen approximates 40 mm. of mercury, anoxic signs are apt to become apparent.

The results of Wilmer and Berens' experiments at 20,000 feet altitude are:

1. Five subjects were examined for color vision by the Stillings test plates and no change was found.

2. The form fields of twenty subjects were examined and the following field contraction was noted:

- 14 per cent contraction of inferior visual field
- 3.5 per cent contraction of temporal visual field
- 4 per cent contraction of superior visual field
- 8 per cent contraction of nasal visual field

3. Muscle duction tests were done on twenty-five men with the following results:

- Abduction decreased 1.55 degrees
- Adduction decreased 1.9 degrees
- Circumvergence decreased 1.23 degrees

In recent military aviation, heights in excess of 35,000 feet are not unusual and in fact are at times strategically necessary. In an experiment (unpublished report) to determine the occurrence of *acro-embolism* (term used in aviation medicine to denote bubble formation in the blood stream by a rapid reduction of barometric pressure) in a series of men who had been pre-oxygenated at sea level or at 20,000 feet, a study was made to determine the effects of altitude on the visual apparatus. Twenty-eight decompressions were made. The altitude equiva-

lents ranged from 20,000 to 40,000 feet. Although fifteen subjects developed signs of "aero-embolism," which was all of the same type, viz., pain around one or more joints, only two showed any ocular change. No change in twenty-six decompressions was noted in muscle balance, visual fields, depth perception or tonometry, which speaks for the efficacy of the methods adopted by the U. S. Navy for the prevention of anoxic signs or symptoms. Five subjects (all hyperopes) developed slight depression of visual acuity which could be ascribed to ciliary fatigue due possibly to ischemia of the ciliary muscle as the result of "aero-embolism." For instance, a hyperope of  $+1.75$  diopters with 20/20 vision before ascent would have 20/30 vision upon descent.

Brief descriptions of the conditions found in the two aforementioned subjects who showed ocular changes at high altitude equivalents seem warranted. One subject, prior to decompression, showed in the left fundus a small white scarred area with no pigmentary reaction directly below the optic disk, about one-third disk diameter in size. There was no evidence of exudate, edema or hemorrhage. The inferior temporal artery traversed this area and was visible throughout. This area was evident as a negative *scotoma* circular in shape and 4 degrees in size, which was not connected with Mariotte's blind spot. The findings of physical examination were negative. This subject was decompressed to 35,000 feet. There was no subjective visual disturbance. After return to sea level pressure, ophthalmoscopic examination showed slight *edema* of the inferior nasal portion of the disk. Viewed with a binocular ophthalmoscope a decided elevation of the retina due to subretinal clear transudate was seen below the disk. This transudate covered the inferior retinal arteries. At the apex of the swollen portion of the edematous retina were two rosette-type hemorrhages. The fovea was stippled. A campimeter taken with 3/330 test object showed a comma-shaped scotoma continuous with the blind spot extending upward and nasalward 30 degrees. Complete resolution occurred in six weeks and repetition of the identical experiment did not result in a recurrence of the eye lesion. We can only speculate as to the cause of this lesion. The increased permeability of the capillary walls may have been due

to the toxic effects of oxygen per se, an anoxic effect from an aero-embolism, or increased intracranial pressure.

The other subject was decompressed to 40,000 feet and showed a 10 degree bitemporal *contraction of the form fields*. If this field change was purely due to anoxemia one would expect a field contraction in all meridians. It is a generally accepted clinical fact that papilledema becomes first manifest in the nasal portions of the disk. Could this then be an effect of increased intracranial pressure without ophthalmoscopic evidence?

Armstrong<sup>s</sup> noted *increased intracranial pressure* in a goat beginning at 18,000 feet where the cisternal manometric pressure was 8 inches of water. At 50,000 feet the intracranial pressure was 32 inches of water. This evidence has not as yet been scientifically refuted and it is obvious that this finding alone is of major importance to the ophthalmologist.

An aero-embolism per se may involve any part of the vascular bed of the eyes or optic tract. Lohlein<sup>9</sup> describes a case of right homonymous *hemianopsia* following rapid ascent and this presumably must be due to an air embolus in a branch of the left posterior cerebral artery.

#### EFFECTS OF PARACHUTE JUMPING ON THE OCULAR APPARATUS

This is mentioned because of the frequency of parachute jumping in present-day warfare. Severe compression of the chest can cause enough rise of venous pressure to obstruct venous return from the eye, leading to *retinal hemorrhage*. Colajanni<sup>10</sup> recorded such a case in 1931. Most of us are aware that traumatic compression of the chest is frequently followed by retinal hemorrhages.

#### WAR INJURIES INVOLVING EYELIDS, ORBITS AND EYEBALLS

Of 48,290 patients with war injuries admitted to a casualty clearing station in 1918, 1.54 per cent suffered from injuries to the eye. Of these eye injuries 0.8 per cent may be classified as serious. The present conflict shows the same proportion of ocular injuries to total injuries.

**Protective Devices.**—To cut down on these injuries various types of visors have been devised. During the war of 1914—

1918 a perforated metal type of visor, such as that developed by Sir Richard Cruise, was used. When not in use this visor could be tucked up in the steel helmet. This type of visor has not proved wholly satisfactory. In wet weather drops of water in the perforations reduce visibility to zero. The visor also interferes with stereoscopic vision, reduces the field of vision and reduces night vision. Protection against bullets of high velocity and an ever-increasing power of penetration demands the use of material and apparatus too cumbersome to wear and too restrictive to mobility and efficiency. The task today is to provide protection to the eyes against missiles of small mass without reducing the eyes as a physiological unit. Missiles of high velocity cannot be stopped except by cumbersome apparatus. Protection can be offered to splinters and dust particles which, because of their low mass, have less powers of penetration. Goggles made of plastics should prove most effective in this field.

**Principles of Treatment.**—Generally speaking, eye surgery in the military sphere differs from that in civilian life in that a wound of the eye is usually virulently infected, with the infection probably some days advanced before surgical interference is possible. The tissues also are far more severely traumatized than are those seen in industrial accidents.

As to the injuries per se, mention will be made only of certain outstanding points. In 1917–1918 the general surgeon was taught to follow a plan of early and extensive débridement of gunshot wounds. However, such a course should not be followed in *wounds of the eyelids*, in which primary suture is indicated. Infection following primary suture is extremely rare and when it does occur it can be easily controlled. Plastic work upon the eyelids varies from civil routine in that one encounters marked defects of the orbital margins and bony structures of the face.

*Small foreign bodies in the orbit* which are not easily accessible should be left unless cellulitis develops. Orbital cellulitis requires free drainage. Chemotherapy would be used today as an adjunctive measure. If lagophthalmos develops as a result of facial palsies or if there is danger of corneal involvement

the eyelids should be sutured. An orbit should never be packed and the orbital tissues should be conserved in doing enucleations and eviscerations. Evisceration is the procedure of choice for a *ruptured and collapsed eyeball* and for *panophthalmitis*.

*Perforating wounds of the cornea* with the prolapse of iris should be treated by excision of the prolapsed iris, covering the wound with a conjunctival flap. The flap keeps infection from the eye and provides a blood supply which aids the healing of the corneal tear.

**Intraocular Foreign Bodies.**—Intraocular foreign bodies are responsible for a great many of the ocular war wounds. These foreign bodies may be of iron, steel, copper, lead, tin, brass, aluminum, glass, gravel, or wood. Shoemaker<sup>11</sup> states that in his experiences about 50 per cent are *magnetic*. To determine whether the foreign body is magnetic the hand magnet is placed near the equator of the eyeball and this zone is tried out in all portions. If the foreign body is magnetic, the patient will unerringly feel a slight pull. If the eyeball contains an open wound of entrance, immediate application of the magnet tip in the wound should be tried. An attempt at *x-ray localization* by the Sweet method should be made if possible. If the anterior segment of the eyeball is intact and the foreign body is in the vitreous, it should be removed by *posterior sclerotomy*. It is obvious that removal by the anterior route would result in damage to the lens, suspensory ligament and ciliary body in such cases. The posterior route as a rule is preferable as offering the minimum risk except for those small foreign bodies not lying against the ciliary body. When x-ray localization is impossible, tiny foreign bodies may be removed by the anterior route without material damage. Intraocular foreign bodies as large as 2 to 4 mm. in diameter can usually be removed without enucleation, and leave a fairly good looking though usually sightless eye. Intraocular foreign bodies of 0.5 to 2 mm. in size generally leave a useful eye after removal.

In work with magnetic apparatus it is well to have non-magnetic eye instruments.

*Nonmagnetic* foreign bodies anterior to the vitreous can be removed by forceps through a corneal incision. If imbedded in



the iris an associated iridectomy is done. Those in the lens can be removed if and when the cataractous lens is extracted.

The consensus now is that nonmagnetic intraocular foreign bodies should be left in situ if they are not easily accessible. The question is wholly one of sympathetic ophthalmia. A sterile, chemically inert foreign body is usually harmless and becomes encysted. A wound involving incarceration of the ciliary body is dangerous.

**Sympathetic Ophthalmia.**—Not one case of blindness from sympathetic ophthalmia was recorded from the American Expeditionary Forces in 1917–1918. Greenwood<sup>12</sup> accounted for this in three ways:

1. All eyes so badly injured anteriorly that a useful eye could not be expected were enucleated.

2. Less devastating anterior injuries were treated antiseptically and often the wounds were sealed by a conjunctival flap, with the result that healing took place without subsequent iridocyclitis.

3. Enucleation was done in all cases of persistent iridocyclitis.

In civilian life, patients are apt not to allow enucleation of an eye which, by reason of traumatic iridocyclitis, endangers the fellow eye, while in military life such eyes are removed at once.

**Detachment of Retina.**—In any wound of the eye, and also by “windage” or concussion waves per se, retinal separation and rupture of the choroid may occur. Detachment of the retina, considered hopeless a few years ago, is now frequently treated successfully by recently developed methods. Gonin in 1925 treated these cases by obliterating ignipuncture. Guist in 1931 used chemical cauterization of the choroid through multiple scleral trephine openings. Diathermic closure was instituted by Larssen in 1930–32, and electrolysis was employed by v. Szily and Machemer in 1934 for the same purpose. Most of the procedures are still new and as yet no final verdict can be given as to the ideal treatment. The great frequency of choroidal tears and retinal detachments as a consequence of trauma incident to war may give the military ophthalmologist the opportunity to determine the ideal treatment in these cases.

# MISCELLANEOUS ITEMS OF ESPECIAL INTEREST IN MILITARY OPHTHALMOLOGY

**Aniseikonia.**—The Dartmouth Eye Group, in a study of the prevalence of aniseikonia in about 400 Naval Aviation Cadets at Pensacola, Florida, found that only 8 per cent had as much as 0.5 per cent aniseikonia, and none over 1 per cent, which is the amount that may be considered of clinical significance. The U. S. Navy, especially the aviation branch, does not regard aniseikonia as of practical importance. The presumption is that the visual requirements in aviation are so rigid that aniseikonia is excluded by the routine eye tests.

**Malingers.**—Frequent mention is made in the literature of the World War of malingering by soldiers. In the U. S. Navy and U. S. Marine Corps, where service is wholly voluntary, the incidence would be presumably less. The following statistics are of interest:<sup>3</sup>

Year	Malingers	Average Strength of Navy
1917	.. 19	245,580
1918	44	503,792
1919	32	298,774

No attempt is made to classify the types of simulation resorted to: thus the figures represent not only ocular malingerers, but other types as well.

From 1930 to 1939 inclusive seventeen cases of malingering were so diagnosed in the U. S. Navy and U. S. Marine Corps. Again the type of simulation is not recorded. The detection of the feigning of uniocular blindness is comparatively simple. Recourse to such tests as Cuignet's test, Harlan's test, and the crossed diplopia test will solve the problem. During the war cases of conjunctivitis which had been self-induced by placing lye or dirt in the conjunctival cul-de-sac were reported. These cases may be difficult to detect. In my personal experience I have yet to see a malingerer in the U. S. Navy or U. S. Marine Corps. Exaggeration may be occasionally resorted to when the "going is tough," but judicious handling of such cases will suffice.

**Night Blindness.**—Whitham<sup>13</sup> states that never in his civilian ophthalmological practice has he heard night blindness so definitely and generally complained of as in the American Expeditionary Forces among soldiers without demonstrable

retinal disease. He was at a loss to account for it. It may well have been due to a deficiency of vitamin A. Certainly our own military forces are well aware of the importance of good dark-adaptation, since much of the fighting today, especially that on the sea and in the air, is done at night. Studies of the prevalence of faulty dark-adaptation are now under way in our military services but as yet no conclusive reports are available. It may be said that the investigative work completed thus far in the U. S. Navy indicates that the evidence points to normal dark-adaptation curves in our officers and men.

**Angioscotomas.**—An angioscotoma is a "defect of the visual field originating from the blind spot of Mariotte and conforms to the pattern of distribution of the retinal vessel tree." Any method which enhances vision is of obvious benefit to the military forces. Rosenthal and Seitz<sup>14</sup> have shown that the administration of benzedrine decreases the size of the angioscotomas, and this fact may well be of importance to our aviation personnel.

**Spectacles.**—Because of the rigid visual requirements of the Services it is unusual to see a sailor or marine dependent on a pair of glasses, and rightly so. Replenishment in case of breakage is usually not practical. Optical shops are practical only aboard a hospital ship or with large forces in the field. It is well for all presbyopes in the military forces to have a spare "just in case."

**Gonococcal Infection of the Conjunctiva.**—In 1918 there were sixty-four cases of gonorrheal conjunctivitis in the U. S. Navy (0.13 per 1000). In 1929 there were four cases (0.03 per 1000). In 1939 after the advent of sulfanilamide compounds there was one case (0.007 per 1000).<sup>4</sup> Gonococcal infection of the conjunctiva thus ceases to be a major ophthalmological problem in the U. S. Navy.

**Exclusion of the Visually Unfit.**—Previous reference has been made to the necessity for excluding those who are visually unfit. During the war years the following numbers were invalidated from the Service because of ocular defects:

1917	294	of which 139 were for faulty vision due to refractive errors
1918	753	of which 329 were for faulty vision due to refractive errors
1919	1407	of which 624 were for faulty vision due to refractive errors

Of these cases 291 were due to the effects of poison gases upon the eyes.<sup>3</sup>

For comparison the same statistics are given for twenty years later as follows:

1937	187	of which 133 were for faulty vision due to refractive errors
1938	142	of which 92 were for faulty vision due to refractive errors
1939	200	of which 138 were for faulty vision due to refractive errors

From these data one can readily see that 50 per cent of those invalided from the service during the war period were for refractive conditions. During the latter period, viz., 1937 to 1939 inclusive, approximately 65 per cent of those invalided from the service were for refractive conditions.<sup>3</sup>

From this evidence alone it would seem that continued rigidity in visual acuity requirement in the U. S. Navy and U. S. Marine Corps should be maintained.

Lastly it may be said that in the great stress of wartime urgent surgery, irrespective of site, must take priority, and we must view the eye in its true perspective when life is at stake. In our hospitals in the quieter moments after battles our ophthalmologists will have unusual opportunity for visual field observations in circumscribed lesions of the brain and in the field of medico-ophthalmology.

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## WAR INJURIES OF THE EAR, NOSE AND THROAT

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### WAR INJURIES OF THE EAR

THE treatment of war injuries of the ear, nose and throat falls naturally into two main classifications, namely, (1) first aid near the place where the injury was received, and (2) treatment to be administered at the base, station, or reconstruction hospital far removed from the actual scene of combat. Generally speaking, and from the lessons learned in the last Great War, as little débridement as possible should be practiced in the type of injuries with which this chapter is concerned. Insofar as possible all tissues, either soft or bony, should be preserved with a view to their possible use in future reconstruction. Routine cleansing should be practiced and sulfanilamide or sulfathiazole powder, when available, should be freely used on the exposed or lacerated surfaces. Recent experience in civil surgery indicates that this is a useful means of minimizing infection. In the last war the Carrel-Dakin treatment was found to be very efficient for this purpose. In the former method, it is essential that the powder be renewed at comparatively short intervals, and in the latter that the tubes be flushed with fresh Dakin solution every two hours.

War injuries of the ear differ little in type from civil, industrial and automobile injuries.

## INJURIES OF THE AURICLE

Injuries to the auricle include the production of hematoma, perichondritis with effusion or suppuration, laceration of the auricle and external auditory meatus, loss of the auricle either in whole or in part and the presence of foreign bodies in the external auditory canal or middle ear.

In the case of foreign bodies, extraction should be done as soon as possible and strict asepsis observed. The canal itself should be carefully cleansed of all foreign matter and free drainage established if the membrana tympani is perforated. *Effusions of blood* beneath the perichondrium of the auricle, when resulting from trauma, will usually be found on the anterior surface which is more exposed and where the perichondrium is more loosely attached to the underlying cartilage than is the case on the posterior surface. Aspiration of the fluid blood under aseptic precaution is desirable, after which a soft but firm pad serves to bring the perichondrium into apposition with the cartilage, thus preventing further bleeding and serving to limit the possibility of infection, necrosis of the cartilage and fibrosis with the end-result of a deforming *cauliflower ear*. A *perichondritis with effusion* is treated in a similar manner. In cases of extensive *laceration of the auricle*, as much of the remaining tissue should be preserved as is possible and the wound sutured with sufficient drainage. If sepsis can be avoided, an auricle which has been largely torn from its attachment may often be preserved with little deformity.

## FOREIGN BODIES IN THE MASTOID PROCESS

Fragments of high explosive shells or bits of stone may penetrate the mastoid process, especially in those cases where there is a thin cortex. At times the skin wound closes and the foreign bodies are not discovered until a later x-ray examination reveals their presence. If causing symptoms they should be removed surgically after proper localization by x-ray.

## LABYRINTHINE INJURIES

**Anatomical Considerations.**—The labyrinth (internal ear) is divided into two main portions, usually designated as the acoustic and static portions, or sometimes as the cochlear and vestibular portions. The latter includes the semicircular

canal system. All portions are contained within the *labyrinthine capsule* which is composed of dense bone. Within the various bony chambers is the *membranous labyrinth*, cushioned against ordinary trauma by the perilymph (of the cerebrospinal system). In this membranous labyrinth are contained the various end-organs concerned with hearing, motion sensing, equilibration, and so on. Both sets of end-organs are supplied by branches of the auditory or eighth nerve—the acoustic and vestibular nerves. All parts of the membranous labyrinth are in communication with each other but the endolymph does not communicate with the perilymph, the endolymphatic chambers being closed. There are openings in the labyrinthine capsule, however, by which infection may pass either outward or inward. These are the round and oval windows into the middle ear, the internal auditory meatus which contains the seventh and eighth nerves, the aqueductus vestibuli to the meninges on the posterior aspect of the petrous pyramid and the aqueductus cochleae which communicates with the subarachnoid space.

**Pathology.**—War injuries to the labyrinth will be found to differ little, if at all, from those contracted in civil life. They may be divided into two main types: those that interfere with or destroy function only and those which endanger life, although this latter classification includes the former. In injuries which do not endanger life, impairment of the various end-organs, with consequent loss of function, results from concussion, compression, or toxins. Labyrinthine injuries may be caused by large explosions, by repeated smaller concussions such as sustained by riveters or boilermakers and the occupants of tanks, planes or submarines, by rifle or machine-gun fire, either in practice or actual battle, by sudden changes in altitude as in aviation, by compression and congestion as in divers and caisson workers, by concussion causing hemorrhage in the labyrinth and by fractures of the skull involving the petrous pyramid, with or without the development of infection. If the fracture communicates with the skin or any mucous surface, and traverses any part of the internal ear, infection is always to be feared. Any mucosa-lined cavity is air-containing and is thus a possible avenue of infection.



*Basal fractures of the skull* may be caused by force exerted upon any portion of the skull or vertebral column. They frequently involve the petrous pyramid of the temporal bone and are then divided into the longitudinal or transverse types.

*Longitudinal fractures* are more common but usually do not directly involve the labyrinth. The line of fracture does, however, often traverse the middle ear or external canal. Hemorrhage and the escape of cerebrospinal fluid are characteristic but damage to the cochlea or vestibular apparatus is only that caused by concussion. It may be accompanied by hemorrhage into the perilymphatic spaces, which in turn will cause deafness. Grove states that these fractures heal by fibrous tissue and not bony union and consequently the danger of meningitis as a complication, even long afterward, is always present.

*Transverse fractures of the pyramid* more frequently involve the labyrinth and thus are the direct cause of deafness and lost vestibular function, although, since they do not as a rule communicate with the outer air, infection, and therefore meningitis, is much less common. Hemorrhage and escape of cerebrospinal fluid do not occur, the main diagnostic symptoms being profound hearing loss plus nausea, vomiting, nystagmus and vertigo.

Injuries to the labyrinth, as far as function is concerned, cause complete or partial deafness by destruction or injury to the end-organs in the acoustic labyrinth or cochlea (organ of Corti), or cause disturbances of balance if the injury is in the vestibule or semicircular canals. These are paired organs so that if the injury is unilateral function is maintained on the opposite side.

**Diagnosis.**—*Acoustic injuries* produce a type of impaired hearing usually known as *nerve* or *perception deafness*. This is characterized by lowered or lost bone conduction and reduction of the high-tone limit. The degree of deafness may be slight or total, depending on the extent of injury. In severe cases, perception for all the tones is lowered or absent. If the middle ear alone is involved, hearing for the low tones only will be affected. *Vestibular injuries* will be recognized by depressed reactions to the caloric or rotation tests. If the injury is sudden (in contradistinction to a long-continued insult as by machine-gun or

rifle fire), vertigo, nausea and vomiting will be characteristic. These symptoms are caused by the overactivity of the opposite labyrinth in a unilateral lesion. Increased reactions to tests are an evidence of a hyperexcitability that is caused by some form of irritation.

**CONCUSSION INJURIES.**—Injuries to the neural mechanism of the internal ear may be caused by violence that does not lead to fracture with consequent destruction and, in most instances, does not result in total loss of function of either the acoustic or vestibular mechanism. Such injuries are due to sudden force applied to any portion of the skull directly or by way of the vertebral column, which causes hemorrhage into the membranous labyrinth or compression of some parts of the neural mechanism, or tears or distorts various portions of the endolymph-containing structures. This force may take the form of concussion from a single loud explosion in the vicinity of the unprotected ear, with immediate loss of labyrinthine function. Gradual loss of function may result from exposure to repeated, prolonged, comparatively small noises such as may be sustained in machine-gun fire, small arms practice, and the like. The result here is entirely comparable to the so-called boiler-makers' deafness of civil life. Injury to the inner ear by concussion is more apt to cause impairment of the acoustic than the vestibular apparatus, and in fact, is usually confined to the former. This is because the vestibular portion of the labyrinth is the older phylogenetically and, therefore, is more resistant to injury.

*Impaired hearing*, often of great degree, usually immediate but in some instances of slower progression, results from concussion applied to the intralabyrinthine structures either by direct skull trauma or by forces transmitted through the membrana tympani, with or without rupture of the drum. *Tinnitus* usually accompanies the deafness, and *vertigo*, most often transitory and mild in character, is not uncommon. In the common form of concussive deafness due to small, repeated and prolonged noises (boiler-makers' deafness) the hearing impairment begins insidiously and progresses slowly over a long period of time. Here again, tinnitus aurium is common but vertigo is rarely encountered.

The diagnosis is made on the history of exposure, the im-

paired hearing and the type of hearing defect as shown by testing the auditory function, due consideration being given to the possibility of malingering. The deafness is of the perceptive variety and most marked in the ear more directly exposed to the causative noise. The eustachian tube is patulous and the tympanic membrane is normal. The *Weber test* (vibrating tuning fork placed on the midline of the skull) lateralizes to the sound ear if the injury is unilateral and to the ear least affected if the involvement is bilateral but unequal. The *Rinne test* is positive (air conduction one-third to one-half longer than bone conduction, but with both diminished), the *Schwabach test* shows diminished bone conduction (with the vibrating fork applied to the mastoid and using a known normal ear as a control), and the high tone limit is lowered in the 8192, 4096, 2048 or lower frequencies as determined by the *Galton whistle* or the *audiometer* if available. In extreme cases, all useful hearing may be abolished but the fact can usually be established, in cases in which no fracture exists, that some vestiges of auditory function remain. In the more severe cases especially, there is a diminished response to the *vestibular tests*, i.e., less marked or slower or briefer nystagmus, pastpointing and vertigo, by either the rotation or caloric methods.

**DIRECT TRAUMA TO LABYRINTH.**—In cases of *fracture of the skull*, with the line of fracture passing through the labyrinth but not involving the middle ear, the above diagnostic points will hold good. If, in addition, there is blood in the external auditory canal which is not due to laceration by metal splinter, gravel, dirt, or the like, the line of fracture will have crossed some portion of this canal or of the middle ear. If the tympanic membrane is intact, involvement of the middle ear can in all probability be ruled out. Cerebrospinal fluid in the external auditory meatus may have come through a fracture line in the mastoid cells, but is more likely to have escaped through a perforation of the drum, showing middle ear involvement. In either case, the probability of labyrinthine involvement is great.

**Prevention.**—One is tempted to make the statement that the surest way to avoid these various injuries is not to go to war, to drive an automobile or walk on the highway or cross a

city street, not to go up in a plane, or to expose oneself to any sudden or continuous noise. In our complex civilization, few people can avoid all of these hazards and even the farmer may fall out of his hayloft, or the baby from its crib. Certain general precautions, if taken with care, will greatly diminish accidents involving the internal ear. The aviator's nose and throat must be in first class condition in order to permit the free and easy ventilation of the middle ear by voluntary, as well as involuntary, opening of the eustachian tube. As height is gained or lost, and atmospheric pressure on the eardrum becomes greater or less, compensation of pressure in the middle ear can thus easily and quickly be adjusted.

In the warfare of forty or more years ago, the soldier serving a large gun was instructed to stand on his toes, keep his mouth open and hold his breath to minimize the force of the concussion. In the speed and hurry of modern warfare, these precautions, whether or not they had value, are no longer possible, and even in the older days few soldiers could be trained to remember them. It remains then to consider some form of *obturator* for the external auditory canal that will diminish, if not wholly prevent, the concussive force from reaching the eardrum. In 1914 to 1918 many devices were tried with some success but the average soldier either soon lost them or failed to remember to use them when the time came, or he was taken unawares by some heavy explosion. The simplest form of ear protector is, therefore, probably the best. It consists of a plug of cotton or lamb's wool, moistened in olive oil, vaseline or glycerin, and packed rather tightly in the external canal. The disadvantage is that hearing is temporarily impaired by this means, orders may be unheard or misunderstood and danger signals disregarded. The metal helmet introduced during the last war and now universally in use will guard against some head injuries and in this respect the deep German helmet with side pieces partly covering the ears will be more effective against injury to the labyrinth by direct penetration through the external canal and middle ear.

**Management of Labyrinthine Injuries.**—It can be laid down as a general principle in the management of all injuries to the labyrinth that as little as possible should be done during

the acute stage. The ear *should not be syringed* and *blood clots should not be removed*. A simple antiseptic external dressing should be applied.

CONCUSSION INJURIES.—In concussion deafness or vestibular disturbance, rest, quiet, and removal to an area where the trauma will not be repeated, is essential. If the acoustic labyrinth has not been irretrievably damaged, it may then be hoped that some return of function may be experienced. In many instances, however, the deafness persists or even becomes worse as time goes on. The tinnitus is often even more intractable. In the boilermakers' type of injury, early impairment of hearing should be watched for and, on its first appearance, the individual placed in a quieter occupation. The administration of thiamine chloride and nicotinic acid has been thought to be helpful. A hearing aid may also help in rehabilitation if enough hearing remains.

DIRECT TRAUMA TO LABYRINTH.—If a *fracture running* through the labyrinth but not communicating with the exterior is suspected, it calls for no special form of treatment other than that employed for any skull fracture. Absolute rest and quiet must be maintained and a sharp lookout kept for early evidences of intracranial complications.

If the fracture is in communication with the exterior by way of a ruptured drum through which blood and cerebrospinal fluid are escaping, certain rules must be followed. The external ear and canal *must not be cleansed under any circumstances whatsoever*. No externally applied fluid should be allowed to reach the tympanic perforation. In spite of the loss of cerebrospinal fluid (perilymph) and blood, a tight plug in the ear must not be used unless the hemorrhage threatens life. Instead, a light sterile gauze dressing should be placed over the external auditory meatus, to prevent the entrance of further infection from the outside. In favorable cases, in the course of a few hours, the bleeding will have ceased and later the flow of cerebrospinal fluid diminishes and stops. At this time, a detailed examination of the drum can be made. Rents in the drum caused by fracture are often linear and heal rapidly. If healing has taken place the canal can be more carefully cleaned, but great care must still be exercised.

Any testing, either auditory or vestibular, will have been avoided up to this time. but with the drum perforation healed and the vertigo, if it was present, gone, careful functional tests may cautiously be made in order to estimate the damage done. If, however, in the course of a few days there appear *symptoms and signs of intracranial involvement*, such as fever, rapid (or slow) pulse, the neurological signs of meningeal irritation, increased spinal fluid pressure and cell count with or without bacteria, chills, sweats, headache and mental changes, inactivity, so advisable until this time, must be promptly supplanted by *activity*, as it is evident that infection of the meninges has taken place. The infection presumably has reached the arachnoid spaces from the labyrinth. If such is the case, the ear will be totally deaf and negative to any vestibular stimulation that can be employed. The patient, however, will probably be too sick for the rotation test and the caloric test should not be employed in the presence of a perforated drum. In such a case, unless the focus of infection in the labyrinth can be promptly drained, death from meningitis may be expected shortly, even if adequate chemotherapy is employed.

*Drainage of the Labyrinth.*—If intracranial involvement occurs, drainage of the labyrinth is mandatory. Before drainage is attempted, a thorough radical mastoid operation is done, with the utmost lowering of the cortex in order to obtain the maximum room. The convexity of the horizontal semicircular canal is outlined and its lumen opened by shaving off the capsule with a small, very sharp, flat chisel or by a sharp curette as advocated by Kerrison. It is to be remembered that the facial canal lies immediately beneath the lower border of the horizontal canal and that a fracture of the bone by the injudicious use of force will cause a facial paralysis. When the lumen of the horizontal canal has been discovered, the uncapping procedure is continued forward until the vestibule is reached. The stapes is now extracted so that a probe bent to three quarters of a circle, if passed through the oval window, will appear in the exposed vestibule, thus passing beneath and internal to the horizontal portion of the facial canal. With the small chisel the small bridge of bone between the round and oval windows is now removed so that drainage of the vestibule is secured both

above and below. If further drainage seems advisable, the promontory is removed with chisel or curette, exposing the first whorl of the cochlea.

The after-care in such a case is that adopted for the standard radical mastoid operation except that no skin graft is employed and the posterior wound is usually left open for a time for better observation and care. If this operation is performed by the endaural route, as advocated by Lempert, there is no difference in the after-care, and in fact, very little is required.

*Injuries to the Facial Nerve.*—If a facial paralysis accompanies a fracture of the skull, no immediate treatment is called for. Some of these paralyses, if due to exudate in the fallopian canal as a result of the trauma, will clear as absorption takes place and pressure is relieved. If, however, the nerve is compressed by fracture through the canal and function does not return after the acute stage of the fracture is over, it should be decompressed by operation through the mastoid. If the nerve has been severed by the fracture or by the entrance of a foreign body, an end-to-end anastomosis should be attempted if there is not too great loss of tissue. In the latter case, a nerve graft may be done at a somewhat later time. In the meantime the tone of the involved facial muscles must be maintained by massage and the use of the galvanic and faradic currents. As long as reactions of degeneration have not taken place there is still a chance of spontaneous recovery, as happens in many cases of thermal paralysis (Bell's palsy).

#### MALINGERING

The feigning of deafness as a basis for claiming exemption from duty during service or compensation after discharge is one of the most common forms of malingering. It, therefore, behooves the military surgeons to be alert to diagnose this situation, but often repeated tests and checks are necessary in order that no stigma attach to an innocent individual.

If severe deafness is claimed to have resulted from direct injury or concussion, *vestibular tests* showing a marked depression of the responses, nystagmus, pastpointing and vertigo, support the assumption that the acoustic division of the laby-

lith is also impaired, and usually to an even greater extent than the vestibular division. Conversely, normal responses to the caloric or rotation tests support the contention that the claimed hearing loss is functional or, at least, grossly exaggerated.

**Routine Examination.**—Admit only one man to the examining room at a time. Find out which ear is supposedly deaf and whether the patient regards his deafness as partial or complete. If only one ear is complained of, make a rapid check-up of the better ear to make certain that it is functionally sound or at least only slightly subnormal. This preliminary examination is of importance for the later check-up. The examiner should appear sympathetic and should never betray any suspicion of the answers elicited.

Apply a 255 d.v. fork to the vertex of the skull and check the side to which it is lateralized. If to the bad ear, it may mean that the man is honest (if the case is a conductive one); if to the good ear, the reference is correct if there is true perceptive deafness present in the other ear. If the answers are opposite to the above, malingering should be suspected. Then proceed with:

**The Loud Voice Test.**—Blindfold the eyes. Occlude the better ear with a cotton plug. Repeat words or numbers in a low voice. At first the voice is low, then louder and stronger. It should soon be heard by the sound ear even though it is tightly occluded. If the examinee still says that he cannot hear the loud voice he is probably malingering. (An alert individual may say that he hears the voice through his occluded normal ear. Be on guard against this.)

**Stenger Test.**—This test is perhaps the most reliable of all. The astute examiner will improvise many variations of this test, which is designed, as are all other tests of simulated deafness, to catch the examinee in intentional misstatements. Two small forks of exactly equal pitch should be used—preferably the small fork *a'* (435 d.v.). The test is based upon the fact that with two equally vibrating forks of identical pitch placed at different distances from two normal ears, the fork nearest to one ear will mask out the hearing for the fork held at a greater distance from the opposite ear. In other words, only the nearest fork will be consciously heard. The claimant should be blindfolded and should not know that two forks are being used simultaneously.

To illustrate, deafness is *claimed* in the right ear. The vibrating forks are held at equal distances from each ear—say 10 inches. If the ears are normal, the examinee will claim no hearing in the right ear—only in the left. If now the right fork is advanced to 3 inches from the right ear, the malingerer will claim that he does not hear with either ear, since the hearing of the left ear is now masked out by the vibrations of the fork close to the falsely claimed deaf right ear, where he will naturally not acknowledge it is heard. If now the left fork is brought to a point 3 inches from the left ear, the patient again admits hearing in that ear.

Sennenschein used the test as follows: "The forks are struck at the same time, and it is first determined at which distance the patient admits hearing the fork in his good ear; let us say 10 inches from the left ear. Since he pretends to be totally deaf in his right ear, he denies hearing the same pitched fork no matter how closely held to the right ear. With one fork vibrating let us say 3 inches from the right or supposedly deaf ear, and the other fork approaching within 6 inches of the left ear, the patient will state that he does



not hear any sound at all even though he previously admitted hearing the fork with the well (left) ear at a distance of 10 inches. The reason is this: The fork held 3 inches from the right ear will drown out the sound of the fork held 6 inches from the left ear, but of whose presence the patient does not know. In view of the fact that he claims to be deaf in the right ear, he will say he hears nothing at all; whereas, if he were really deaf in his right ear he would not hear the tuning-fork held near that ear, but would certainly hear the one vibrating in the vicinity of the left or well ear. Thus the diagnosis of malingering is established." Various quick changes in the positions of the two forks will soon confuse even a patient who has had some coaching in this test, and a few mistakes will convict him.

**Stethoscope Test.**—Use a funnel-shaped stethoscope with an extra long tube. Occlude one ear piece with wax (occlusion with cotton will not exclude the sound). Stand behind the examinee, and adjust the stethoscope *with the occluded ear piece in his "deaf" ear*. Words in a low voice are spoken into the funnel-shaped chest piece, which he should naturally hear and repeat (because the sounds are coming into his normal ear). Remove the stethoscope for the presumed purpose of doing another test with something else, then place the occluded ear piece in his sound ear (he should not hear anything). If, however, he is able to hear approximately as well as before, it means that his deafness is either assumed or grossly exaggerated. This is a fairly reliable test. An easy variation consists in pinching first one tube and then the other in order to change the flow of sound or to stop it altogether.

**Tests for Eliciting Contradictory Responses.**—Uncover the eyes, close the sound or better ear with a finger and subject the "deaf" ear to every test (conversation, voice, whisper, watch, tuning forks, etc.), and make careful notation of the examinee's responses. Then blindfold his eyes, and repeat all of these tests, many times, rather rapidly, and in varying order. If he is a malingerer and has not in the first instance claimed almost total deafness, his responses will almost surely demonstrate incongruous and contradictory variations.

**Lombard's Test.**—Place the Bárány nose apparatus in the sound ear. Start the noise, and let the examinee hear the grating sound of the apparatus, so as to accustom him to the sound. Give him a book to read and tell him to continue reading aloud in his natural voice and not to stop reading when the noise instrument is set in motion. Continuous counting from 1 to 100 serves the same purpose. *If his open ear is profoundly deaf he will raise his voice—if his deafness is absolute he will probably shout*, when the noise begins in the good ear. The voice will immediately return to normal when the noise stops. The malingerer (unless coached) will continue to read in an even tone or one only slightly elevated.

**Cochlea-palpebral Test (Gault).**—Close the sound ear tightly, and make a noise near the supposedly bad ear. If a slight winking movement or a contraction of the lid of the corresponding eye takes place, it means that the sound was heard in the ear. A change in the size of the pupil also indicates hearing. This test may be more valuable in claimed bilateral deafness.

**"Chimani-Moos" Test.**—A large-sized tuning fork, C<sub>2</sub>, is held alternately at an equal distance from each ear. In this manner it becomes self-evident that the tone is heard better in the ear which is claimed to be sound. The vibrating tuning fork is then placed on the median line of the vertex, or against the incisor teeth and the patient is asked to indicate in which ear the tone is better perceived. The patient with true aural disease affecting the sound-conducting

apparatus will state without hesitation that he hears the tone much louder in the diseased ear, while the malingering, after hesitating for a moment, inasmuch as he is really unable to distinguish any difference of perception in the two ears, thinks that he is answering correctly by stating that he hears the tone in the "normal" ear. If, then, the external meatus of the "normal" ear is tightly closed and the vibrating fork is again placed on the vertex or incisor teeth, the individual, if really deaf, will now say that he hears the tone better in the closed normal ear; or, he may no longer be able to distinguish on which side he perceives the tone. The malingering, with the normal ear tightly closed, will state that he does not hear the tuning fork placed upon the vertex or incisor teeth at all.

**Erhard's Test.**—If the external meatus of a normal ear is tightly packed it will conduct the sound waves to a limited extent, a loud ticking watch being heard at a distance of 2 or 3 meters. Erhard places the malingering in the middle of a large room, closes the ear which is said to be deaf, and then brings a loud ticking watch gradually toward the normal ear and orders the patient to count the beats. The normal ear is then tightly closed and the supposed diseased ear examined. If the malingering claims that he does not hear the watch-tick at a distance of 1 or 2 meters (the distance at which the tick should be heard in the closed normal ear), simulating should be suspected.

**Bilateral Deafness.**—No absolute test can with certainty disclose profound bilateral deafness, but various tests should be repeated many times, and in addition disparaging remarks may be made in an effort to elicit a reply. The majority of malingerers do not pretend to be suffering from complete deafness. The best method is to do a complete set of tests, then blindfold the eyes and repeat them. Use voice, whistle, full set of tuning forks, and so on. No malingering can have such a phenomenal memory and such a musical ear as to repeat all responses correctly. The patient falsely claiming complete bilateral deafness must be caught "in flagrante delicto." During recovery from an anesthetic or when suddenly awakened, he may give himself away. Shouts of fire, the dropping of coins on the floor, unexpected orders or questions may catch such a one off guard. If the suspect is kept constantly under observation for long periods he is almost sure to betray himself sooner or later.

## WAR INJURIES OF THE NOSE AND THROAT

Injuries to the nose and throat incident to war and military activities present many problems to the otolaryngologist, many of which are similar to those encountered in peacetime in connection with traumatic surgery and industrial burns. There are, however, many elements entering into these cases during military activity which are never, or rarely, encountered in peacetime. During war, cases occur in large numbers and not sporadically, they are apt to occur under conditions which are far more difficult regarding immediate care, and transportation to the hospital is apt to present difficulties which predispose to complications that might be guarded against during peacetime.

The types of injuries are various: burns of the face and

neck from back-flash of guns and bombs, incendiary bombs, gasoline explosions and burning oil; chemical burns from war gases; burns from broken electric cables; scalds due to wrecking of steam gear; traumatic injuries to the face and bones of the face with much, little, or no loss of tissue; wounds involving the larynx by crushing, by direct penetration, or secondarily as a result of injury to the adjacent tissues; injuries to the upper respiratory tract as a whole due to various war gases. Injuries in the present type of warfare are not confined to the combat forces but, with the extension of aerial warfare and the increase in the range of heavy guns, civilian casualties are heavy.

### BURNS

Burns by gasoline are fairly frequent afloat and ashore. Huge numbers of gasoline-propelled machines are used in modern warfare and fuel tanks are frequently struck. Bombing may scatter flaming gasoline over a large area, involving both civilian and military casualties. Fuel oil may catch fire on the water after the sinking of a ship and many casualties have been thus caused. Electrical burns occur from broken wires or short-circuits. Incendiary bombs and shells cause other burns, but these are not so common. Phosphorus, used in some incendiaries, may adhere to bits of the metal casing and enter the wound with the missile which causes it. When this occurs the phosphorus continues to burn in the depths of the wound, causing further injury. It has been found that, in these cases, if a 2 per cent copper sulfate solution can be introduced into the wound to the piece of metal, it will form an inert coating about it and check the burning. Burns with the thermite-magnesium bombs are rare. These bombs are made by filling a magnesium casing with thermite (iron oxide and aluminum) and are set off by a flash of priming powder which causes both the contents and the casing to burn at a temperature of about 5000° F. These can be smothered but cannot be put out in any other way.

Premature shell explosions and back-flash from guns and bombs may cause serious burns of exposed parts, particularly the face and hands. Most of these can be guarded against by the use of anti-flash gear to protect these areas.

No matter what the cause of the burn, the primary aim of treatment should be the prevention of shock, as this is the most active factor in causing death in these casualties. Treatment of the burn itself comes next and they should all be considered as infected, and so treated.

**Shock.**—Shock may be *primary*, occurring at the time of burning or shortly thereafter. The patient appears to be in a fainting condition and is usually badly frightened. Anxiety and pain make the condition worse and so morphine is indicated at once to allay both. This with the maintenance of body heat will usually control the situation. This primary shock may pass directly into the *secondary* shock or the latter may not appear for several hours. The patient seems to go into collapse and the seriousness is apparent when one realizes that it is the probable cause of 80 per cent of the deaths from burns. If the primary shock is successfully combated and proper measures are taken, the secondary shock may be prevented.

*The Physiology of Shock.*—Primary shock is most commonly due to impulses set up by the injury producing a reflex vasodilation and a marked fall in blood pressure, which, in turn, affects the cerebral blood supply and causes a loss of consciousness. In secondary shock various factors enter and the reflex stimulation probably plays no part. It has been experimentally determined that the crushing of the hind leg of an animal will produce a fall in blood pressure to the degree found in shock, and that it will occur even though all nerves to the part have been previously severed, thus eliminating reflex stimulation. In these experiments shock could be prevented if the vessel were clamped to prevent venous return from the area, and quickly caused to appear by removing the clamps and allowing the venous flow to become reestablished.

This all suggests the presence of some *toxin* produced in the damaged tissues which is the causative agent in producing shock. What this toxin is has not been definitely determined, but there is a strong suspicion that histamine may be a large factor as it is present in all body tissues and is readily liberated by even simple injury, and also because many of the symptoms of shock are also those of histamine poisoning: low blood pressure, rapid pulse, diminished blood volume with increased viscosity

neck from back-flash of guns and bombs, incendiary bombs, gasoline explosions and burning oil; chemical burns from war gases; burns from broken electric cables; scalds due to wrecking of steam gear; traumatic injuries to the face and bones of the face with much, little, or no loss of tissue; wounds involving the larynx by crushing, by direct penetration, or secondarily as a result of injury to the adjacent tissues; injuries to the upper respiratory tract as a whole due to various war gases. Injuries in the present type of warfare are not confined to the combat forces but, with the extension of aerial warfare and the increase in the range of heavy guns, civilian casualties are heavy.

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with marked success. Gentian violet and tannic acid in jelly form, or tannic acid spray, may be used. Hot drinks are given in as great a volume as the patient will take, particularly glucose drinks to prevent acidosis. If a blood bank is available, plasma in 450- to 500-cc. doses is given intravenously.

After being admitted to the hospital the patient is given gas and oxygen and the burned surface is thoroughly cleansed, after which the area is dried and sprayed, both drying and spraying being repeated until the area is completely tanned. As moist areas develop they are dried and sprayed as required. Chemical burns are washed for a full two minutes with water, after which *acid* burns are dressed with a sodium bicarbonate solution,  $\frac{1}{2}$  ounce to a pint of water, and *alkali* burns with citric acid, 1:100. Six hours later the dressings are removed and the area is treated with cod liver oil.

#### WOUNDS OF THE FACE

Wounds of the face may be caused by bullets and fragments of shell or bomb, or by pieces of stone or other debris thrown by a nearby explosion. High velocity bullets striking fair may make small wounds and pieces of fragmentation bombs may cause an almost invisible wound. Ricocheting bullets or those which strike at the end of their trajectory may produce tremendous damage, and the larger shell or bomb fragments also. These wounds are very destructive and may produce compound comminuted fractures of the face with varying degrees of tissue loss without proving fatal. The facial tissues are so well supplied with blood vessels that, in spite of marked traumatism of the tissues, there is a high degree of resistance to infection and capacity for recovery. This is particularly fortunate as practically all wounds of the face are bound to communicate with the nasal or oral cavities, which are almost sure to contain pathogenic organisms which make infection of these wounds almost impossible to prevent.

Fortunately *gas gangrene*, which incidentally does not appear to be a factor in wounds of the present war, rarely occurs. Probably this is due to the excellent blood supply, the comparative shallowness of the wounds and the fact that they pass through an area which is in close contact with air and thus are

and rise in hemoglobin. Other depressor bodies which have been isolated from the tissues are choline and derivatives of it and adenylic acid. It may be that all of these are concerned in shock and some physiologists believe that there may be different depressor bodies liberated by different tissues.

*Effects of Shock on the Organism.*—In severe shock the lowering of the blood pressure and slowing of the circulation are so marked that they result in malnutrition of all of the tissues. Anxiety, dullness and apathy develop as a result of anoxia. Persistence of the low blood pressure affects the medullary centers, particularly the vasomotor, and so tends to prolong shock. Owing to the same factors the basal metabolism is reduced, and this in turn tends to cause a still further fall in body temperature.

*Treatment of Shock.*—An important factor in shock is fluid imbalance. There is a great loss of plasma into the tissue spaces, and compared to this the amount lost externally is small. Proper balance must be restored in treatment. Whole blood transfusions are contraindicated because they produce mechanical block of the capillaries through concentration of the blood cells. Intravenous saline is also contraindicated as it tends to increase edema. Intravenous sterile water may produce water intoxication by lowering the extracellular electrolytic concentration. Intravenous administration of *blood plasma* is best as it tends to restore normal osmotic pressure and, after its restoration, tends to maintain the normal distribution of vascular and interstitial fluids.

*Treatment of Burns.*—An understanding of the physiology of shock will make the intelligent institution of treatment easier. The efficiency of the first aid may do much to prevent shock and lessen complications. The immediate use of morphine to allay pain and anxiety, and the maintenance of body heat, are first considerations. When the patient is dulled by the morphine the burn is cleansed as thoroughly as possible and then sprayed with a 2 per cent gentian violet solution, or with a triple dye solution. The latter is made of gentian violet, 1 per cent, brilliant green, 1 per cent, and neutral acriflavine, 0.1 per cent. This is the method advocated by Wakely of the Royal Navy Medical Service and has been used by the Royal Navy

Treatment of all facial wounds must aim first at the preservation of life, then at the prevention and correction of facial deformity and management of fractured jaws. Disfigurement when it occurs may be due to the tearing away of facial structure by the missile or its destruction by necrosis. Later, disfigurement may be due to distortion from contracture of scar tissue, faulty apposition of supporting bone, or loss of bone.

Because of the comparative lack of tissue in the face, loss of tissue is of serious consequence and every effort should be made to conserve every possible bit of skin and underlying tissue so as to lessen facial deformity. General approval is given to excision of tissue in war wounds of other parts of the body, but *in the face excision should never be done*. Insofar as possible, wounds should be cleansed of all foreign matter and débris. Whenever possible, tears of the mucosal lining of the mouth should be closed to lessen contamination from this area. As swelling of the parts subsides, the soft tissues are gradually brought together into the best possible position and the whole area is immobilized. *Immobilization* is important as movement of the wounded parts is a significant factor in the causation of sepsis.

In *sino-facial wounds* the area permits a closure of the external wounds as complete as the tissues will allow, and also intranasal drainage. This is true of all sino-facial wounds no matter at what period the surgeon first sees the wound, what the state of infection is, or what ocular or dental complication may be present. When seen the wound is thoroughly cleansed, preferably under anesthesia, all possible tissue is preserved and the sinus cavities are inspected. All foreign matter and bone particles are removed, a large opening is made from the sinus into the nasal cavity for drainage, and the external wound is sutured. Some surgeons advocate packing the sinus with gauze for twenty-four to forty-eight hours. Following this, if the amount of secretion demands it, lavage of the cavity may be done, but not until five or six days have elapsed.

#### FRACTURES OF THE JAWS

In wounds causing fractures of the jaws, upper or lower, the situation is complicated by difficulties arising from dis-



not favorable to the growth of anaerobic organisms. Infections are usually mixed and staphylococci, hemolytic streptococci and colon bacilli seem to predominate in the wounds of the present war.

**Salivary Glands.**—Naturally, wounds of the face and jaws frequently involve the salivary glands and their ducts. Most of these seem to heal spontaneously, but a salivary fistula may persist for some time. The use of irradiation hastens closure. Involvement of the parotid gland at times gives rise to serious hemorrhage, since the external carotid artery enters the gland and there gives off the posterior auricular and sometimes the occipital arteries, and divides into the temporal and internal maxillary branches. The facial nerve may be injured as it passes through the gland.

**Tongue.**—The tongue should also be given separate consideration as wounds of this organ may produce serious complications. There is a rich blood supply through the branches of the lingual artery and serious hemorrhage may occur. Infection may spread from the wound into the base of the tongue and pharyngeal wall and this, in turn, may produce edema of the glottis. Fragments of bone or bits of shell lodged in the tongue should be removed as soon as possible, the wound cleansed and the margins brought together. Healing usually occurs rather readily.

**Treatment.**—Facial wounds may involve the brain as well as the sinuses and the dangers to the brain are increased owing to the sinus communication. In many cases in which involvement of the frontal sinus occurs with a brain wound, reinfection from the sinus has been prevented by cleansing the wound and suturing the dura. It is more difficult to shut off the other sinuses, and when these are involved in brain injuries the incidence of meningitis is higher.

Maintenance of the airway is vitally important. Tubes may have to be introduced through the nose to the pharynx or into the trachea. Tracheotomy may be needed owing to swelling or edema which follows the trauma or sepsis, to interference with proper muscular action due to paralysis from injury to nerves, or to displacement of the bony fragments in fracture of the jaws.

of a like consistency may be taken in behind the last molars or through space left by missing teeth. Minced meats and vegetables are added as the patient's condition improves. Free use of mouth washes to keep the oral cavity as clean as possible is important both before and after eating.

**Union.**—Union of these fractures takes place rapidly in some cases, more slowly in others, depending upon the character and location of the fracture and the general condition of the patient. In the simple cases the jaws may be unlocked in about three weeks' time and the upper splint removed so that the patient may use his jaw. In the more severe cases, and if bone grafts have been required, immobilization may be maintained for eight to nine weeks, after which, if union seems firm, the jaws are unlocked by removing the upper splint. The lower splint, however, is retained for four to eight weeks longer. If the lower jaw has not united by this time it is wise to do nothing further for another three or four months for fear of again starting up infection. If the ununited fracture is at the neck or ramus of the jaw, further surgery is rarely indicated since the important masseter and internal pterygoid muscles are still attached and function of the jaw can still be maintained. If, on the other hand, the fracture is in the body of the mandible, nonunion presents a marked disability unless there is sufficient dense fibrous tissue to hold the fragments in place.

**Nonunion.**—Nonunion of the mandible may be treated by *wiring* or by *bone grafts* after the lapse of several months. If there are teeth near the fractured ends they should be removed and time allowed for the alveolar processes to become absorbed.

One objection to *wiring* is that it frequently results in narrowing of the jaw and causes malocclusion and in addition some further facial deformity. This is brought about by the necessity of exposing the fractured ends and removing the scar tissue and diseased bone down to healthy bone. In some cases a satisfactory result may be obtained by binding the fragments together with silver wire or kangaroo tendon, after removal of only a small amount of bone. *Metal plates* may be used.

If there is much loss of bony tissue, better results are obtained by *bone grafting*. The fragments are wired to the upper

placed teeth, displaced or broken roots, comminution of the bone and displacement of fragments by the action of the muscles attached to them. Fractures may be bilateral.

Transverse fractures through the *orbits* or the *maxillae*, where the main bony mass is separated from the skull, will result in sagging of the whole face. These fractures may best be managed by an upper dental splint with arms protruding at the angle of the jaw on each side. These arms are attached to a skull cap which holds the fragments up and in place.

Depressed fractures of the *malar bones* may be elevated into place from within the antrum through the nose or pulled into place by a sharp gimlet or hook inserted through the soft tissues.

Fractures of the *mandible* may be treated by interdental splints or by wiring. Surgical plating or wiring of the fragments is not desirable in the acute cases, since it requires further incision, results in damage to the tissues and introduces further foreign matter into the wounds. Bringing the teeth into occlusion with the corresponding teeth of the upper jaw, and holding the mandible in position by proper support, may suffice in certain cases. If this is done, one should avoid any traction backward as this would cause displacement of the bone and a receding chin. A support made of broad rubber dam passed under the jaws and up over the head where it is tied to a head bandage is often satisfactory.

*Immobilization* of the jaws should always be done as early as possible, since movement of the jaws contribute to the development of sepsis. Antiseptic mouth washes should be used freely. Should sepsis appear with rise of temperature, swelling and tenderness, incision should not be done early if it can be avoided, as it is better to allow for localization to occur and then drain through a small incision. If necrosis of bone occurs the progress should be watched by x-ray until the sequestrum is separated at which time, and not before, it should be removed. This will lessen further damage.

**Feeding.**—Feeding during the period of immobilization is limited to liquids during the first few days. These can be taken in through the teeth. Later, junket, custards, porridge and foods

## WAR GAS INJURIES

War gases have not been used to date in the present war so there is little new information regarding gas casualties. Our present knowledge is dependent upon experimental work and the study of gas casualties of the first World War.

*Mustard* gas affects the mucosa of the entire respiratory tract as well as the skin surfaces with which it comes in contact. The extent of the injury depends upon the concentration of the gas and the length of exposure, together with the susceptibility of the patient. Mucosal involvement varies from slight inflammation to the formation of a membrane which resembles diphtheria. Skin contamination with the gas is treated by using a solvent: kerosene, acetone, absolute alcohol, petrolatum, olive oil or ordinary lubricating oil, followed by a thorough washing with soap and water. Chloride of lime will destroy mustard gas by oxidation. Inhalation of the gas is treated by cleansing the nose, mouth and pharynx with sodium bicarbonate solution and the inhalation of menthol and tincture of benzoin compound in steam. Ordinarily this is all that need be done in addition to rest and nonuse of the voice.

*Lewisite* is a highly toxic gas both upon inhalation and upon contact with the skin. As it contains arsenic, treatment must aim to prevent the absorption of a lethal amount. It is very irritant to all surfaces, producing excessive nasal and lacrimal secretion, going on to block the nose, and even lower down, with a membrane; retching and vomiting occur; edema of the trachea and lungs may appear. Irrigations of the nose and oral cavity with alkaline solutions, and soothing steam inhalations should be employed. If the skin is involved, wash with an alkaline solution (5 per cent hydroxide of sodium works well) and then with soap and water. Burns with lewisite may be excised even though the area involved is quite large (up to 12 square inches), and will usually heal by first intention.

*Phosgene* produces little or no local changes in the upper respiratory tract but causes changes in the lungs.

*Chlorine* produces a congestion and edema of the entire respiratory tract and may even cause sloughing of the mucosa. Ammonia by inhalation is a chemical antidote, producing ammonium chloride. Cough and spasm may be allayed by inhaling

jaw in the proper occlusive position, after denuding the ends of the fragments and cutting a step in each. Exact measurements of the required graft may thus be obtained. The graft may be taken from a rib, tibia, or crest of the ilium, depending upon the site of the gap to be filled and the shape of the piece best adapted to fit it. Steps are cut in it to fit the steps in the jaw and the piece fastened in place. In certain cases a pedicle graft may be obtained from the lower border of one of the fragments by cutting off the piece of bone but allowing the muscle to remain attached, then swinging it over to bridge the gap.

### WOUNDS OF THE LARYNX

Wounds of the larynx occur less frequently than other wounds about the head, but they are extremely serious and should always be regarded as emergencies. *Tracheotomy* is indicated in practically all. Stretcher bearers should receive special instruction as to immediate care. The patient is prevented from speaking and is given a sedative by hypodermic at once, together with atropine. If there is marked dyspnea he may be more comfortably carried with the head bent backward, since this position presses the larynx onto the spine and tends to widen it, and lessens the aspiration of blood. If there is an accompanying fracture of the larynx, however, this position might make the situation worse. Tracheotomy must often be done on the field if the patient is to be saved. External hemorrhage is taken care of by ligation, by tamponade, or by pressure of the artery on the deeper structures. Laryngeal edema and emphysema may develop and the latter extend to the mediastinum. Early tracheotomy may lessen this danger.

If the larynx has been crushed or fractured there may be troublesome hemorrhage from the mucosal vessels in addition to mechanical obstruction to breathing. Early laryngofissure should be done in these cases. If the missile has opened the trachea where it can be reached, it is wise to clean the wound and insert a cannula. Often it is impossible to tell whether the esophagus, as well as the larynx, has been injured, consequently no fluids should be given by mouth. As soon as possible, however, fluids should be given by bowel or intravenously to prevent dehydration.

## MILITARY DERMATOLOGY AND SYPHILOLOGY\*

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THE facts and figures in this article are derived entirely from experiences and statistics of the Medical Corps of the U. S. Navy. There will be some dissimilarities between these and Army statistics and observations. However, we believe that the similarities will far exceed the divergences; so that, *mutatis mutandis*, that which is set forth here may apply in great measure to military dermatology and syphilology in general.

### INCIDENCE OF CUTANEOUS DISEASES IN THE U. S. NAVY

Any superficial examination of published Naval statistics is likely to give an entirely erroneous picture of the incidence of skin diseases. For example, trichophytosis, scabies, and pediculosis are not now classified under "Skin Diseases," but in the class known as "Diseases Caused by Fungi and Certain Animal Parasites"; erysipelas, furuncles (boils), carbuncles, etc., are

\* The opinions or assertions contained in this work are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

compound tincture of benzoin in steam. Fresh air and even direct administration of oxygen may be needed.

*Chloropicrin* is a respiratory irritant and lacrimator. It is corrosive if the liquid touches the skin, but is not as severe or necrotizing as chlorine.

*First aid* in any gas involvement should consist in the removal of impregnated clothes, maintenance of body warmth, rest, stimulation if required, neutralization of any gas on the skin by alkalies and washing with soap and water, inhalation of ammonia and irrigation of the nose and throat with alkaline solutions, and inhalation of steam containing compound tincture of benzoin. The administration of oxygen is indicated in some cases.

entire group of dermatologic and syphilologic diseases to the other largest single group of diseases in the Navy (Communicable Diseases Transmissible by Oral and Nasal Discharges).

It will be seen that 6.12 per cent of all sick days are due to skin diseases; and that this is considerably more than the sick days due to syphilis (4.82 per cent).

According to Table 1 the combined Department of Dermatology and Syphilology would treat 14.86 per cent of patients admitted to the sick list for all diseases. These published figures are certainly too low, because many skin diseases appearing in Naval personnel are not reported to the medical officer or are so mild that they are treated without admission to the sick list. Even excluding these very numerous ambulatory cases of skin disease, if one considers "skin disease" as a single entity, it will be seen that cutaneous disorders are the third most

TABLE 2

COMPARISON OF RATE OF ADMISSION FOR COMMON SKIN DISEASES, AND FIVE OTHER MOST COMMON CAUSES OF ADMISSION, U. S. NAVY (1929-1938 INC.)

	Average Admission Rate per 1000 Men
1. Catarrhal fever (acute)	85 71
2. Gonorrhea	61 24
3. Skin diseases	22 56
4. Tonsillitis (acute)	22 32
5. Syphilis	19 28
6. Appendicitis (acute and chronic)	13 39

frequent cause of morbidity (Table 2). Since it is likely that more than 60 to 70 per cent of all dermatoses are treated as ambulatory cases and probably do not appear in these statistics of incidence, the actual occurrence of skin diseases in the Navy can be conservatively estimated as being at least double that shown by the above figures.

These compilations deal only with peacetime incidence, and do not take into consideration the inevitable wartime or mobilization increase to be expected in scabies, fungous infections, pediculosis, and so on, and in burns and skin damage from chemical warfare agents; nor do these figures indicate the tremendous increases to be expected in occupational and industrial skin diseases in Navy Yards and manufacturing plants connected with defense expansion.



not classified as skin diseases but as "Other Diseases of Infective Type"; warts, xanthomas, epitheliomas, rodent ulcers, melanomas, angiomas, nevi, etc., are not classed as skin diseases but as "Tumors."

In order to obtain an approximately accurate estimate of the importance of dermatology and syphilology in the Navy we were, therefore, obliged to collect from the different classifications employed and to sum up the various common skin and

TABLE 1  
COMPARATIVE INCIDENCE AND MORBIDITY OF DISEASES IN THE DERMATOLOGY  
AND SYPHILOLOGY GROUP

Disease or Group	Admissions 1929-38 (inc )	Per Cent Total of All Admissions for Disease	Sick Days 1929-38 (inc )	Per Cent Total of All Sick Days for Disease
Skin diseases	30,366	6 07	629,610	6 12
Syphilis	22,423	4 43	495,761	4 82
Chancroid	21,562	4 26	113,496	1 10
Granuloma inguinale and lymphogranuloma (venereum)	526	0 10	16,566	0 16
Total	74,877	14 86	1,255,433	12 208
For comparison Class VIII* 1929-1938 (inc )	163,452	32 32	1,254,636	12 204

\* Class VIII is "Communicable diseases transmissible by oral and nasal discharges." This class includes acute catarrhal fever, acute tonsillitis, influenza, measles and other contagious diseases, and stood first in admissions as a class in all years except in 1930 when venereal diseases were first.

NOTE The figures for skin diseases in all tables were based on diseases ordinarily treated by a dermatologist and not as classified in the annual report of the Surgeon General of the Navy.

venereal diseases which usually come within the scope of a Department of Dermatology and Syphilology. In this manner, and by taking the average of ten recent years (1929 to 1938 inclusive), we have calculated the incidence of common skin diseases, of syphilis, chancroid, lymphogranuloma venereum (lymphopathia venerea) and granuloma inguinale in the Navy. Table 1 sets forth the result of this calculation and gives the comparative incidence of these diseases and the ratio of the

entire group of dermatologic and syphilologic diseases to the other largest single group of diseases in the Navy (Communicable Diseases Transmissible by Oral and Nasal Discharges).

It will be seen that 6.12 per cent of all sick days are due to skin diseases; and that this is considerably more than the sick days due to syphilis (4.82 per cent).

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The relationship between the incidence of individual common skin diseases and between these skin diseases and other common diseases is further analyzed in Tables 3, 4, 5 and 6.

TABLE 3

TRICHOPHYTOSIS AND SCABIES AS COMPARED OVER A TEN-YEAR PERIOD WITH THE TEN LEADING CAUSES OF ADMISSION IN 1929

Disease	Total Admissions	Per Cent of Total Admissions for All Diseases	Average Admission Rate per 1000 (1929-38 inc.)
1. Catarrhal fever, acute	101,160	20.06	85.71
2. Gonococcal infection, urethra	71,915	14 16	61.24
3. Tonsillitis, acute	26,416	5 22	22.32
4. Syphilis	22,413	4.43	19.28
5. Chancroid	21,562	4 26	18.49
6. Cellulitis	16,808	3 33	14.18
7. Tonsillitis, chronic	16,598	3.29	14.10
8. Appendicitis, acute and chronic	16,369	3.26	13 79
9. Influenza	8,674	1.62	7.44
10. Scabies	6,532	1.31	5.58
11. Trichophytosis	5,827	1 16	4.94
12. Malaria	4,243	0.80	3.63

NOTE: Scabies and trichophytosis stood 18 and 19 respectively in rate of admissions in 1929.

TABLE 4

TOTAL SICK DAYS AND PERCENTAGE OF TOTAL SICK DAYS FOR TRICHOPHYTOSIS AND SCABIES FOR THE PERIOD 1929 TO 1938 (INC) AS COMPARED WITH THE TEN LEADING CAUSES FOR ADMISSION IN 1929

Disease	Total Sick Days	Per Cent of Total Sick Days—All Diseases
1. Gonococcal infection, urethra	646,997	6 27
2. Catarrhal fever, acute	539,042	5 25
3. Syphilis	495,761	4 82
4. Appendicitis, acute and chronic	470,830	4 59
5. Tonsillitis, chronic	420,750	4 10
6. Tonsillitis, acute	207,207	1 99
7. Cellulitis	186,911	1 81
8. Trichophytosis	166,514	1 63
9. Chancroid	113,496	1 10
10. Malaria	108,915	1 09
11. Influenza	70,754	67
12. Scabies	65,581	64

It will be seen that among the skin diseases *trichophytosis* (ringworm) and *scabies* are consistently the two principal

TABLE 2  
ADMISSION RATE PER 1000 MEN, FOR DISEASES OF THE SKIN

Disease	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
1. Scabies	(1) 4.67	(2) 4.03	(1) 5.50	(1) 6.96	(1) 8.94	(1) 6.48	(1) 5.29	(1) 5.01	(1) 4.28	(1) 4.90
2. Trichophytosis	(2) 4.59	(1) 4.21	(2) 5.21	(2) 5.32	(2) 5.58	(2) 5.92	(2) 4.85	(2) 4.94	(2) 4.03	(2) 4.51
3. Furunculosis	(3) 2.73	(3) 2.40	(3) 2.63	(3) 2.60	(3) 2.83	(4) 2.29	(4) 2.28	(3) 2.37	(3) 2.33	(3) 2.27
4. Vaccinia	(5) 1.35	(8) 0.59	(5) 1.16	(5) 0.98	(5) 1.29	(3) 3.47	(3) 2.70	(4) 2.16	(8) 0.62	(8) 0.60
5. Ingrowing nail	(4) 1.77	(4) 1.54	(4) 1.55	(4) 1.29	(4) 1.31	(6) 1.12	(5) 1.37	(5) 1.09	(4) 1.32	(4) 1.33
6. Ulcer, skin	(6) 0.86	(6) 0.90	(7) 0.84	(9) 0.67	(8) 0.91	(9) 0.64	(9) 0.53	(9) 0.62	(9) 0.56	(9) 0.49
7. Impetigo contagiosa and unclassified	(7) 0.59	(5) 0.93	(6) 1.07	(6) 0.92	(6) 1.25	(5) 1.30	(7) 0.85	(6) 1.01	(7) 0.68	(7) 0.66
8. Eczema	(8) 0.54	(10) 0.50	(10) 0.27	(10) 0.36	(10) 0.37	(10) 0.35	(10) 0.27	(10) 0.20	(10) 0.25	(10) 0.23
9. Urticaria	(9) 0.48	(9) 0.56	(8) 0.80	(7) 0.76	(7) 0.97	(7) 1.02	(6) 0.98	(8) 0.83	(5) 0.90	(5) 0.85
10. Dermatitis venenata	(10) 0.44	(7) 0.64	(9) 0.65	(8) 0.64	(9) 0.71	(8) 0.78	(8) 0.73	(7) 0.92	(6) 0.75	(6) 0.83
Other skin diseases	3.77	3.63	3.40	3.64	3.77	3.92	3.45	3.44	2.78	3.41
Total	21.79	19.93	23.08	24.14	27.93	27.29	23.30	22.59	18.50	20.08

Disease	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
1. Scabies...	(2) 50 92	(2) 49 25	(2) 67 49	(2) 82 13	(2) 90 29	(2) 62 21	(2) 40 18	(2) 34 57	(2) 27 40	(2) 32 34
2. Trichophytosis	(1) 142 77	(1) 138 23	(1) 145 81	(1) 131 87	(1) 123 36	(1) 131 42	(1) 113 01	(1) 100 78	(1) 95 02	(1) 102 83
3. Furunculosis	(3) 36 59	(4) 29 28	(4) 31 16	(3) 32 24	(3) 37 49	(3) 30 69	(3) 27 36	(3) 29 39	(3) 24 47	(3) 24 29
4. Vaccinia	(8) 6 96	(10) 3 42	(10) 5 46	(10) 4 02	(10) 6 06	(6) 15 57	(7) 11 34	(8) 9 07	(10) 2 54	(10) 2 52
5. Ingrowing nail	(5) 27 31	(6) 23 29	(5) 21 34	(5) 17 14	(6) 19 26	(7) 13 78	(5) 14 93	(5) 17 99	(4) 22 97	(4) 19 68
6. Ulcer, skin	(4) 35 32	(3) 44 81	(3) 35 22	(6) 16 35	(4) 28 03	(5) 19 65	(4) 17 76	(4) 19 72	(5) 22 79	(5) 16 76
7. Eczema	(6) 22 94	(5) 26 76	(6) 21 12	(7) 14 80	(7) 13 91	(8) 13 41	(9) 8 86	(9) 7 58	(8) 8 15	(6) 14 08
8. Impetigo contagiosa and unclassified	(7) 10 86	(7) 13 17	(7) 19 31	(4) 18 68	(5) 19 50	(4) 19 89	(6) 12 07	(6) 13 13	(9) 7 83	(8) 10 23
9. Urticaria	(10) 4 83	(8) 9 02	(8) 9 38	(8) 10 26	(9) 10 48	(10) 8 98	(8) 10 68	(10) 7 30	(6) 10 44	(7) 12 07
10. Dermatitis venenata.	(9) 5 49	(9) 8 34	(9) 7 95	(9) 9 02	(8) 10 86	(9) 11 47	(10) 7 52	(7) 11 78	(7) 9 60	(9) 8 72
All other skin diseases...	109 35	101 0	101 91	87 43	106 44	102 91	79 03	77 12	133 25	98 34
...	452 11	410 57	466 15	423 91	465 68	429 98	342 71	328 13	364 16	310 86

dermatologic causes of morbidity and rank high (usually tenth and eleventh) in incidence of diseases in general.

The principal problems of military dermatology and syphilology are those of prevention and of reducing the morbidity due to common skin diseases and syphilis. Some important aspects of these problems will be taken up individually.

#### PROBLEMS IN PARASITIC SKIN DISEASES

{Fungous Infections [Ringworm, Athlete's Foot, Otomycoses, etc.]; Scabies and Pediculosis}

Under the conditions of massing of troops and naval personnel, an increase in *trichophytosis*, *scabies* and *pediculosis* is almost inevitable. During all previous wars, and during the last war in particular, these diseases became a veritable scourge, and in some armies and districts were the principal causes of ineffectiveness among troops (Trench foot, cooties, etc.). Indeed, the spread both of scabies and of *ringworm of the feet* ("athlete's foot") received such a tremendous impetus in this country during the first World War and after the last demobilization, that even today the incidence of these diseases among the civilian population in the United States has not yet been reduced to anything approaching the normal pre-war level. Since the last war, the dermatologist's knowledge of the causes of the outbreaks of ringworm has been greatly augmented. Modern methods of prophylaxis will, if properly and generally applied, undoubtedly reduce the disability caused by this group of diseases. It is the task of the military dermato-syphilologist to see that the modern methods are standardized and applied in routine fashion throughout all base hospitals, ships, stations and other places of military congregation. Moreover, the study and comparison of the effectiveness of the different methods now championed by various authorities can best be executed by trained physicians within the military forces. In the Navy the usual segregation of different military units (ships, divisions, squadrons, fleets), and the excellent opportunities for "follow-up," offer the most suitable field for comparative studies and controlled statistical evaluation of different methods of prevention.

SICK DAYS PER YEAR PER 1000 MEN, FOR DISEASES OF THE SKIN

Disease	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
1. Scabies. . .	(2) 50 92	(2) 49 25	(2) 67 49	(2) 82 13	(2) 90 29	(2) 62 21	(2) 40 18	(2) 34 57	(2) 27 40	(2) 32 34
2. Trichophytosis	(1) 142 77	(1) 138 23	(1) 145 81	(1) 131 87	(1) 123 36	(1) 131 42	(1) 113 01	(1) 100 78	(1) 95 02	(1) 102 83
3. Furunculosis	(3) 36 59	(4) 29 28	(4) 31 16	(3) 32 24	(3) 37 49	(3) 30 69	(3) 27 36	(3) 29 39	(3) 24 47	(3) 21 29
4. Vaccinia	(8) 6 96	(10) 3 42	(10) 5 46	(10) 4 02	(10) 6 06	(6) 15 57	(7) 11 34	(8) 9 07	(10) 2 54	(10) 2 52
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7. Eczema	(6) 22 94	(5) 26 76	(6) 21 12	(7) 14 80	(7) 13 91	(8) 13 41	(9) 8 86	(9) 7 58	(8) 8 15	(6) 14 08
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All other skin diseases . .	109 35	101 0	101 91	87 43	106 44	102 91	79 03	77 12	133 25	98 34

Intensive training courses in industrial medicine are now being given to selected Naval medical officers. That there is full recognition of the prime importance of industrial dermatology was amply evident in the course on Industrial Dermatoses at which one of the authors was recently asked to assist. This course, given by Dr. Louis Schwartz of the U. S. Public Health Service, was under the auspices of Dr. Flinn of the Institute of Public Health of Columbia University. Here Naval medical officers were privileged to attend a twelve-hour course on industrial dermatology, representing perhaps the most complete coverage of this subject ever presented to students.

**Agents and Hazards.**—The skin hazards encountered in military and associated activities are of course legion. The more important agents and hazards include the following: plants (poison ivy, sumac, etc.), biting insects, turpentine, paints, thinners, varnishes, lacquers, cutting and lubricating oils, explosives (trinitrotoluol and newer nitro-compounds and picric acid derivatives, tetryl, fulminate of mercury etc.), pitches, natural and artificial resins, rubber and its ingredients, accelerators, barnacle-proof compounds, chemicals used in preparing metals and metal stamping dies, colors, dyes and dye intermediates, and insulating materials such as chlorodiphenyls, and a multitude of other widely varied eczematogenous agents. To this list must be added the effects of sunburn, electrical burns, chemical burns, and actual burns by fire, scalding and explosion; as well as the skin damage produced by vesicants such as mustard agent, lewisite and other agents of chemical warfare. In all of these the dermatologic department will follow its triple objective of (1) prevention; (2) effective treatment to shorten morbidity, and (3) *study, incention and appraisal* of methods of prophylaxis and management.

Almost without exception, it may be expected that in each of these fields the application of newer methods of dermatology and of allergy will result in clearer understanding of the processes leading to skin damage and will yield a larger degree of protection (the three C's—protective Cleanliness, Clothing and Creams), a more efficient elimination or reduction of harmful contacts, and in some instances at least to successful methods for desensitization.



The preceding remarks apply with equal force to the *treatment* of fungous infection of the skin. If the dermatologist is given the opportunity and if he fulfills his appointed task he should emerge from the present mobilization with practical and scientifically controlled and proved methods, not only for preventing epidemics, but also for shortening the disability due to fungous disease.

The various newer methods for preventing the spread of scabies and pediculosis, and for the combating of insects, can also best be tried out and compared in military establishments; and it is part of the dermatologist's task to select the most effective and practical methods, and see to their standardization and execution.

It is obvious that the preceding remarks have general significance. Not only in fungous diseases, and not only in dermatology and syphilology, but in all branches of medicine, the controlled conditions obtainable in military organizations often offer unparalleled opportunities for statistical and comparative studies regarding the practicability and effectiveness of competing methods.

#### PROBLEMS IN INDUSTRIAL DERMATOSES AND SKIN ALLERGY

There is perhaps no field of medicine in which greater progress has been made than in that captioned above. Since over *70 per cent of all industrial disease is skin disease*, it follows that the work of the dermatologist is of paramount importance in this group. Needless to say, the efficient functioning of essential war industries, both within and without the military establishment (Army, Navy and Marine Corps plants and manufacturing centers, Navy Yards, civilian factories and depots, etc.), depends upon the reduction in morbidity due to industrial hazards—and here diseases which affect the skin are in the foreground. The prevention and treatment of industrial skin disease, the study of individual skin hazards, of the skin-irritating or skin-sensitizing (allergenic) properties of various processes and compounds, are among the most important functions of the military dermatologist.

duration of the contact of the agent with the skin, the use of prophylactic materials prior to contact, the time interval between exposure and the initiation of therapy, and the type and the technic of the therapy. As a rule, the *longer* the interval between the actual skin contact and the appearance of lesions ("reaction time"), the *less* severe will be the cutaneous reaction.

**Persistent Agents: Mustard and Lewisite.**—Of the two most important persistent agents, mustard and lewisite, the reaction time or latent period is much shorter with lewisite (mustard agent, two to eight hours, lewisite, fifteen to thirty minutes). The skin reaction may vary from simple erythema to deep necrosis surrounded by a rim of vesicobullous lesions. *Pruritus* is a disturbing concomitant of all skin reactions from the persistent agents. In the early phases of vapor burns the individual may seem to have a severe sunburn, later he may seem to have a severe poison ivy dermatitis. Varying degrees of *systemic arsenic poisoning* are often the greatest hazards associated with lewisite burns.

It is frequently not possible to differentiate clinically between a mustard and a lewisite burn of the skin.

**Secondary Infections.**—The healing of the skin lesions of mustard and lewisite is slow, and secondary infection, with all its complications, often occurs. If the face has not been protected by a gas mask, severe irritation of the eyes, mouth and tracheobronchial tree may occur. Secondary bronchopneumonia follows. It was this bronchopneumonia which was chiefly responsible for deaths from the mustard agent.

**Allergic Skin Reactions.**—Recent studies have proved that these persistent materials are strong *sensitizing* agents (allergens); and in some individuals repeated skin contacts will produce allergic skin reactions of varying types. In such sensitized individuals, old burn sites have been known to flare up with inhalations of very weak concentrations of the mustard agent. This recognition of allergy as a factor in some of these reactions makes the study of all possible desensitizing and immunizing measures a necessary part of any organized program for the discovery of methods of protection against small amounts of vesicant agents.

An additional word is perhaps warranted in regard to the two last-mentioned causes of dermatitis, namely, *burns and damage due to agents of chemical warfare*.

#### PROBLEMS IN THE DERMATOLOGIC MANAGEMENT OF BURNS

In all forms of burns the skin, and therefore the dermatologist, is most directly implicated. Ever since the great Viennese dermatologist, Hebra, contributed his classic studies of burns (about 1850) the dermatologic classification of burns into those of first, second and third degree has been universally accepted; and the methods of dermatologic topical management have formed an essential, and often the most important, part of treatment (continuous baths, sprays with tannic acid, silver nitrate, topical application of sulfonamides, etc.). As in many other conditions, the closest possible collaboration of the military dermatologist with the surgeon and internist is necessary to obtain the best results in all burns with extensive involvement of the skin. And the specially trained personnel and special equipment of a well organized dermatologic service will provide the best possible facilities for insuring proper management.

#### PROBLEMS CONNECTED WITH SKIN DAMAGE DUE TO AGENTS OF CHEMICAL WARFARE (VESICANT AGENTS)\*

Chemical warfare agents produce skin irritation in their manufacture, occasionally during their use in the varied training exercises—and, of course, during combat periods. Although the gas mask itself and the so-called *lacrimators* (used only for training purposes) may produce slight and transient dermatitis about the eyes and on the face, the *persistent* chemical warfare compounds cause the majority of the skin lesions in chemical warfare. It is because of their blistering qualities that these latter agents are called the *vesicant gases*, or more correctly, *vesicant compounds*. The severity of the skin reaction depends upon such factors as the skin sensitivity of the individual, the concentration of the agent on the skin surface, the

\* Dr. Leon Goldman, of Cincinnati, has been engaged in special dermatologic studies in this field. We are greatly indebted to Dr. Goldman for his kind assistance in the preparation of these passages on chemical warfare agents.

moval various bleaching powder mixtures may be used for the mustard burns; and sodium hydroxide preparations for the lewisite burns.\* For the bullous phase of the dermatitis, tannic acid (compound solutions) and the silver nitrate technic may be employed.

The following *compound tannic acid solution* has been suggested by Fantus and has the advantage of being stable. We have found this solution effective for more than a year after preparation.

Potassium chloride	0.42 gm.
Calcium chloride	0.80 gm.
Salicylic acid	1.00 gm.
Sodium chloride	10.50 gm.
Tannic acid	100.00 gm.
Distilled water to make	1000.00 cc.

If clear solution is desired, the mixture may be filtered after standing. The vesicle or bulla must be débrided before the tannic acid solution is applied. As a rule, one application of tannic acid solution followed in ten or fifteen minutes by an application of 10 per cent silver nitrate solution will be sufficient to produce a firm crust.

*Those taking care of these contaminated cases must be rigorously protected; otherwise they, too, will become casualties.* Special care must be taken to obviate carrying the liquid agents on shoes into the treatment rooms.

**Nonpersistent Agents; Incendiary Bombs.**—The non-persistent agents cause little skin irritation, but the contents of incendiary bombs may cause severe burns. Other incendiary agents of the combustible oil type may also cause severe burns. If one is near the discharge of concealing smokes, skin lesions may be caused. Smokes of the phosphorus type cause phosphorus burns and smokes of the other types cause small drop-like acid burns.

\* The Chemical Warfare Service does not permit publicity on any newly developed protective materials, however, they indicate that bleaching powder paste or cream may be used. The bleaching powder is made with equal parts of water. It must be rinsed off the skin to avoid irritation. The bleaching powder cream must be freshly prepared, two parts of bleaching powder to one part of white petrolatum.

*Protective Measures.*—The gas mask will protect the face, eyes and respiratory tract against the persistent agents. Special materials are needed to protect the remainder of the skin surface, since these vesicant agents penetrate leather, rubber, ordinary clothing, etc. Some of the methods of industrial protection and some of the newer synthetic resins and plastics which have been introduced in industrial dermatology to protect against industrial skin disease appear to offer advantages also for protection against vesicant agents. (Clothing of Pliofilm, Vinylite, Coraseal, etc.; clothing and underwear fabrics rendered impermeable by fabric finishes containing artificial resins; protective oxidizing creams containing sodium perborate [Schwarz] or dichloramine-T; etc.)

*Prevention of Dermatitis after Contact.*—To prevent dermatitis, mustard agent must be removed from the skin not later than ten minutes after contact, lewisite not later than five minutes after contact. The therapeutic materials usually employed are soap and water and/or the organic solvents (kerosene, gasoline, carbon tetrachloride). Newer agents recommended by the British for removing lewisite are: (1) hydrogen peroxide, 70 volumes; and (2) 20 per cent hyperol or perhydrite (urea peroxide). All these must be used in a very correct and exact manner, otherwise they will spread the vesicant more widely over the skin.\* Following these first measures of re-

\* These solvents must be used very carefully. First the skin is patted gently (not rubbed) with absorbent material (blotting paper, etc.), allowing as much of the agent to soak up as possible. Then the cloth soaked with the solvent is used more as a blotting paper than as a scrubbing rag. The contaminated spots are dabbed, then the cloths are discarded. After the cloth has touched a contaminated spot, this cloth is likewise contaminated. Anyone using the cloths must be protected with special gloves and special clothing. The cloths must not be used on another individual. The mustard agent, of course, evaporates from the cloth and so contaminates the air also.

Soap and water should be used in about the same manner. Cloths soaked in soapy water should be patted on the skin, not scrubbed or rubbed. Scrubbing and rubbing will merely distribute the mustard agent over the skin surface. It is better to start at the edges of the contaminated skin areas and pat toward the center. These soapy rags must be discarded since they are dangerous not only for contact irritation, but also for evaporation of mustard. The personnel using these cloths must also wear protective equipment. Following the use of the soapy cloths, fresh damp cloths may be used to pat the skin gently. The skin should then be patted dry and the various therapeutic materials used after that.

- 1 case of early Kaposi's sarcoma
- 1 case of lipoid proteinosis
- 1 case of epidermolysis bullosa hereditaria

Many of these conditions were present at enlistment and the man and the service could have been spared the expense and disruption due to enlistment and later necessary medical discharge.

**Other Problems.**—The other problems of the dermatologist in the Navy are essentially similar to those of the same branch of civilian medicine. In the larger military institutions the dermatologist's cases will include all of cutaneous medicine. There will be patients of all ages and of both sexes, as represented by (1) veterans, (2) retired personnel, (3) dependents, and (4) civilian employees—in addition to service personnel. As stated previously, a very large proportion of all skin cases will be treated ambulatorily; and the set-up of a Dermatologic Service must include all the facilities of an *outpatient department* and *minor surgical clinic*.

### SYPHILIS

What is said here is based entirely on experience with the problem of syphilis in the Navy. But the whole matter should be equally applicable to Army practice since the viewpoint aims and public health aspects in syphilis do not differ in the two services and the differences as to regulations are only slight.

**Incidence.**—Until very recent years syphilis was considered the most important disease in the Navy, because it had the highest incidence of any disease which is capable of frequent killings or crippling; and prior to 1936 was responsible for about 40,000 sick days per year. The incidence rate, however, has been dropping steadily since 1932, and since 1936 has remained at about 10 new infections per 1000 men per year reaching the new low level of 7.4 for the year 1940.

**Seriousness to Personnel.**—Many other factors beside the prevalence and seriousness of syphilis contribute to its great importance in a military organization. The treatment which continues for at least a year, and may continue for several years, necessitates a great number of excuses from du-

## PROBLEMS IN RELATION TO OTHER SKIN DISEASES

In the service personnel of the Navy the general incidence of skin diseases is approximately that found in any comparable civilian group. However, certain skin diseases appear to be somewhat above the norm in incidence—these include not only ringworm and scabies, but also: (1) skin diseases due to oils, greases, tars and pitches (acne, furuncles, carbuncles, etc.); (2) skin diseases due to exposure to the elements (sunburn, photosensitivity, lupus erythematosus, rosacea, epitheliomas in young men); (3) skin diseases due to paints, cleansers, solvents, soaps, and the like (dermatitis and impetiginized dermatitis particularly of the hands, forearms, legs, and other exposed parts); (4) chronic pyodermas (pus infections), including chronic impetigo, furunculosis, folliculitis and particularly ecthyma.

**Detection of Skin Lesions Likely to Lead to Unfitness for Service.**—It is an important function of the dermatologist in the military establishment to spot as early as possible (preferably before enlistment) the skin lesions which are or will sooner or later be a cause of *unfitness for service*, and differentiate these eruptions from those *unlikely* to render the man unfit. In the decision as to unfitness the physician must consider not only contagious or actually incapacitating skin diseases, but also those innocent eruptions (psoriasis, acne and the like) which are sufficiently apparent and unsightly to preclude the man's effective participation in the military organization (undressing and living with others in close quarters, etc.). Moreover, a chronic and severe itch may impair a man's efficiency (at a gun, for example) more than many internal conditions without such distressing subjective manifestations.

The point we wish to make here is perhaps best emphasized by the following partial list of the skin conditions which one of the authors has encountered in Naval personnel in the last six months, and which impelled him to recommend that the affected men be considered unfit for service:

- 3 cases of psoriasis
- 2 cases of lupus erythematosus with photosensitivity
- 2 cases of dermatitis due to allergy to shoe leather
- 3 cases of severe cystic acne (oil?)

their curability. The efficiency of the military machine is influenced by our ability to preserve the health of those infected with syphilis, and this in turn depends largely on our ability to make an early diagnosis.

*Improved Trends in Diagnostic Ability.*—A careful study of the chart (Fig. 201) will reveal much more than just the incidence of syphilis in the Navy during the past fifteen years. It shows two other very important things. First, it shows a decidedly improved trend in our diagnostic ability since 1932. And second, it shows that this ability is still regrettably far short of our ideal.

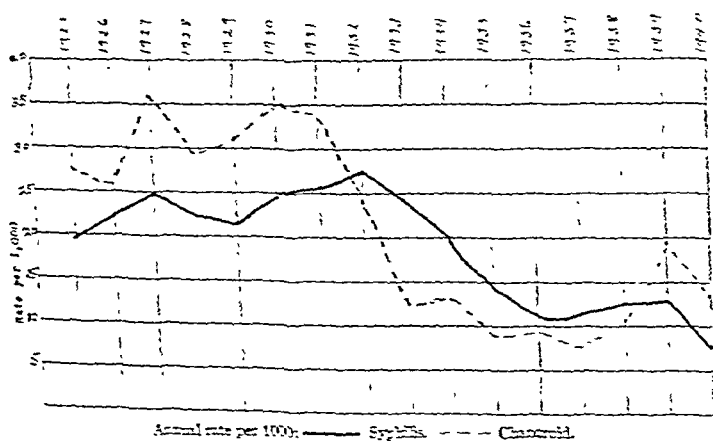


Fig. 201.—Relative frequency of the diagnosis of syphilis and of chancreoid in the Navy (1925 to 1940 inclusive).

It is axiomatic that about 90 per cent of all genital ulcers in males of military age are syphilitic. Yet, as far back as our statistics go, the chancreoid graph always remained above the syphilis graph—until 1932. The chancreoid graph represents only cases in which the diagnosis was not later changed to syphilis. It is also axiomatic that some 90 per cent of primary syphilitic lesions will give positive darkfields. This indicates that the darkfield was not widely and expertly used in the Navy until 1932, and that its use since then has increased both in extent and in skill. Also, the graphs suggest that since 1932 there has been an increasing practice of repeated follow-up



in order for the men to receive the treatments and thereby impedes very considerably the efficiency of the military machine. Men with early infectious syphilis are isolated and kept on the sick list. The military organization loses their services for that period and the men lose their pay and their shore liberty for the period with a consequent serious lowering of their morale. Men with syphilis, early or late, are kept in a special category and are ineligible for transfer to many ships and stations, either because of the unavailability of treatment at those places or for a variety of other reasons. They are stigmatized and penalized in many ways.

For example, an enlisted man who has an entry of syphilis in his health record, no matter how certain that we may be that he has been cured, and even though the infection was acquired in a nonvenereal manner, is forever ineligible for advancement to warrant or commissioned rank. Commissioned officers who acquire syphilis venereally will: if in the Reserve be placed in an inactive status; if in the regular service and holding a provisional commission be dismissed; if holding a permanent commission be—as a matter of tradition—passed over for promotion whenever considered by a selection board. All these circumstances have, of course, a most unfavorable influence on the morale of infected personnel, both enlisted and commissioned. Improvement in this official attitude towards syphilis would seem to be not only warranted, but desirable.

**Diagnosis.**—Next to our aim of preventing syphilis, our great interest is in diagnosing it *at its earliest possible moment*. The later syphilitic lesions such as cardiovascular and central nervous system involvements are of much less interest to the military medical officer than to the civilian physician. The medical officer's task in such lesions is simply to diagnose them and get the patient discharged from the service as unfit. From then on their care is in the hands of comparatively few medical officers—those at the large military hospitals, where retired as well as active personnel are treated.

But early syphilis is quite another matter, and is the vital concern of every medical officer. This is because curability depends so much on early diagnosis and adequate treatment, and the retention of infected men in the service depends on

this consisting of thirty injections each (three courses of ten injections each) of mapharsen and bismuth, with a five-week overlap in the first mapharsen and bismuth course. The treatment program is not a matter of regulation, but all medical officers are indoctrinated as to modern standards.

*Neoarsphenamine* was long our mainstay, reaching the high point of 138,000 injections for the year 1933. Since that time the use of neoarsphenamine has declined steadily in the Navy, only 37,000 injections being given in 1940. *Mapharsen* was first used in the Navy in 1935, when 573 injections of it were given. Its use then rose as steadily as the use of neoarsphenamine declined, and 81,000 injections were given in 1940. The chief reason for this trend has been the comparatively high incidence of untoward reactions, both fatal and nonfatal, following neoarsphenamine administration. Since 1924 more than a million injections of neoarsphenamine have been used, with a fatal reaction ratio of 1 to 26,755 injections. To date more than 200,000 injections of mapharsen have been used *without fatal reaction*. In nonfatal reactions, the ratio of reactions to injections has shown mapharsen to produce them only about *one fifth* as often as neoarsphenamine.

*Importance of Accurate Records and Continuous Treatment.*—One of the most important responsibilities of the medical officer is that of keeping accurate and detailed records of all syphilitics. These data become a permanent part of the man's health record, which follows him wherever he goes, enabling the medical officer at his new station to have complete information as to past treatment and the course of the disease. It is also the duty of the medical officer to maintain the continuity of treatment. *No lapses in treatment can be permitted during the first year of the injection* and it is up to the medical officer to prevent any transfers or even temporary trips or duties which will result in a lapse from treatment. The only warrantable interference with continuity of treatment is when the men's services are required in events of extreme military urgency.

*Prophylaxis.*—Volumes have been written and said on the subject of prophylaxis, and the problem is indeed complex, many factors entering into the general forces that may reduce the venereal disease rate. The subject cannot be covered even

serological and physical examinations in cases of genital lesions where the diagnosis of syphilis was not made on the first examination. Since it is a fair assumption that 90 per cent of the genital ulcers were actually syphilitic and were not chancroids, the extent of the height of the syphilis graph above that of the chancroid graph is in a measure an index of our diagnostic ability and thoroughness.

*Drop in Syphilis Rate in the General Population.*—But another factor may now have entered the picture and deserves consideration. The drop in the Navy syphilis rate since 1936 has been so remarkable that we are struck with the probability that it is a reflection of an actual drop in syphilis among the civilian population. Because of many conditions of military life and military medicine we believe these graphs come much closer to representing actual conditions than can be shown by surveys among any civilian group. And it may well be that the sources of syphilitic infection have so declined in number that we must now revise our 90 per cent rule about genital lesions. It may be that our graphs of syphilitic genital lesions need not now remain very much higher than our graphs of nonsyphilitic genital lesions in order to avoid unfavorable comment on our diagnostic work. During the past year we have seen syphilitic genital lesions only three times as often as nonsyphilitic lesions. This in comparison to a rather constant ratio of about 10 to 1 in former years.

*Diagnosis in the Primary Stage.*—Our ideal is to diagnose all cases in the seronegative primary period—but actually any organization will do extremely well to come within 50 per cent of such a state of perfection. About 10 per cent of primary sores are extragenital and thus are rarely suspected by the patient, and not too often by the physician. In about 20 per cent of infections the primary lesion is so inconspicuous as to be unnoticed and such cases are never diagnosed until later lesions or symptoms occur.

*Treatment.*—As to treatment, the principles are of course no different in military than in civil medicine. But having the control of military discipline over the men, a higher ideal of adequacy can be attained in military practice. In the Navy, a year of continuous treatment is the minimum for early syphilis,

progress of the disease must be kept; and these records must follow the patient whenever he is transferred to a new command.

10. Continuity of treatment in the first year should never lapse. This is the medical officer's responsibility.

#### CHANCROID AND LYMPHOGRANULOMA VENEREUM

The application of the *Ito-Reenstierna skin test* in chancroid was first developed in the dermatologic clinic of C. Bruck. This test has been further studied, in this country particularly, by Sanderson, Greenblatt, Cole and others. Its usefulness as a diagnostic measure cannot be doubted, and skin tests with streptobacillus emulsions should be routine procedure in every naval hospital.

The same remark applies with even greater force to the *Frei skin test*, developed by the great modern dermatologist, Wilhelm Frei, in lymphogranuloma venereum; for the discovery and use of this test has revolutionized our concepts of venereal granulomas. Certainly both the streptobacillus skin test and the Frei skin test should be as much a matter of course in a venereal service as is a serologic test for syphilis.

As far as therapy is concerned, we cannot omit mention of the encouraging results obtained with *sulfonamides* in early lymphogranuloma inguinale; and the brilliant successes of these drugs in the treatment of chancroid.

#### THE NEED FOR A SEPARATE SERVICE IN DERMATOLOGY AND SYPHILOLOGY IN MILITARY ORGANIZATIONS

With the recognition of the importance of military dermatology and syphilology, the Surgeon General of the Navy is now inaugurating a plan to establish and organize more or less independent services in this specialty in all large and permanent Naval hospitals. As far as possible, specially qualified physicians holding the certificates of the American Board of Dermatology and Syphilology will undoubtedly be placed in charge of these services.

The urologist's point of view regarding the advantages of such a separation of services is set forth clearly in the article

in a rough way in an article of this length. But the most important fact, it is firmly believed, can be covered in one word—condoms.

**Rules for the Management of Syphilis Cases.**—During the past twenty years one of the present authors has been engaged in the daily examination of large numbers of syphilitic patients and their case reports, and has been impressed repeatedly with certain of the most common and most important faults in the handling of syphilis cases in the Navy. These faults have led to the formulation of a set of rules which, if followed, should bring the handling of syphilis in military medicine to a point where it will be much less open to reproach than it has been in the past. The rules are as follows:

1. An ulcer on any part of the body and not obviously of nonsyphilitic origin calls for three months of investigation (darkfields, serology, etc.) unless diagnosed as syphilis earlier.
2. An ulcer on the genitalia calls for "darkfields" on at least three successive days unless a positive is obtained earlier.
3. No local treatment should be applied to suspected primary lesions before the "darkfields" are done. No general treatment should ever be given before the diagnosis of syphilis has been established.
4. Beginning two weeks after the appearance of a genital ulcer, the Kahn test and/or other adequate serologic tests should be repeated weekly for ten weeks (unless the lesion is diagnosed as syphilis before the end of that period).
5. The Kahn or other adequate tests should be repeated at the end of each course of treatment (in order to determine prognosis and to plan future treatment).
6. A quick check-up examination of each patient is to be made on treatment days, in order to observe such matters as relapse, treatment tolerance, skin eruptions, etc.
7. The permanent contraindications to further arsenical treatment are limited essentially to the blood dyscrasias and the purpuric or exfoliative types of dermatitis.
8. Spinal fluid examination should be done in all "Kahn fast" cases and routinely at the end of the first year of treatment.
9. Detailed records of every event in the treatment and

## NUTRITIONAL ASPECTS OF MILITARY MEDICINE\*

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### PROBLEMS IN FEEDING TROOPS

THE problem of feeding the soldier is very complex, consisting as it does (1) in attaining adequate nutrition to meet the physiological requirements of the body to enable him to function effectively, and (2) in maintaining morale throughout the service and preparing the food in such a way that he feels he is well fed.

**Morale.**—There is considerable evidence that if the physiological needs are met the method of presentation of food, provided it is clean and wholesome, becomes less important on an adequate than on an inadequate diet. Certainly we have evidence that if the soldier is not adequately fed his morale is lowered. The factors that contribute to his morale—that go to make him a well fed, satisfied soldier—are less tangible than his physiological requirements. The latter can be defined fairly satisfactorily insofar as we have knowledge of the nutrients. Satisfaction is, on the other hand, determined by conditions which are as variable as the individual himself. They include individual food habits and folkways, mass reactions, the selection and method of preparation and service of the food itself—even the weather.

**Cost.**—The matter of cost is at times, unfortunately, a limiting factor, either adversely or favorably, to the soldier's diet. The whole scheme of garrison rationing is keyed to money value with little factual attention to adequacy of the diet pur-

\* The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the War Department or the military service at large.

on "Military Urological Surgery," by Captain Carson and Lieutenant Commander Bidgood (*Surgical Clinics of North America*, Symposium on Military Surgery, December, 1941).

The scope and functions of a separate Service of Dermatology and Syphilology could be only barely indicated in our present article. They will include general improvements in the prevention and treatment of skin diseases and syphilis; the training of physicians and personnel in special clinical and laboratory procedures; and the discovery, investigation, development, evaluation and standardization of new methods.

**Problems Requiring Study Today.**—The following are among the numerous problems which Departments of Dermatology and Syphilology in military organizations should be prepared to study immediately:

**A. Skin Diseases:**

1. Improvement and standardization of methods of prophylaxis and treatment of fungous diseases.
2. Improvement and standardization of methods for reducing the incidence and morbidity due to industrial skin diseases.
3. Improvement and standardization of methods for protection against vesicant agents of chemical warfare; and for care of these casualties and of those due to burns.

**B. Syphilis:**

Study of newer methods of prophylaxis and treatment, including, for example:

1. The action of newer bismuth preparations given by mouth (sobisminol mass); and
2. The "six-day massive treatment by intravenous drip," and its possible applicability to military syphilology; in particular its possible modifications in the form of *massive* doses of mapharsen given daily by means of *small syringes* in *ambulatory patients*.

ciency and attention to detail make for success; and lack of knowledge, poor training and carelessness form the basis of discontent and poor nutrition.

**Interesting and Attractive Food.**—The primary function of the mess personnel is to prepare and serve the available food in a form that will be attractive to the organization. Some necessary foods are uninteresting and they must be prepared in such a way that they will be eaten—often a difficult task.

Attractiveness and interest in food are attainable in two ways: (1) by making a variety of interesting combinations of foods, or (2) by depending upon a variety of foods without much variation in the methods of preparation. Since at times the selection of foods in the Army may be limited, the mess personnel should be thoroughly trained in varied methods of preparing foods and in devices by which variety is attained with a limited selection of foods. The satisfactory preparation of food is not enough: the method of service many times makes the difference between a satisfactory and an unsatisfactory meal. For example, hot, cold, or crisp foods must be served while they are still hot, cold, or crisp, respectively, and food put on the plate or mess kit carefully. The training of mess personnel needs to be more than perfunctory. Knowledge of the reasons for various procedures in cooking and in preserving nutritive values gives a background which assures a good mess under the variety of conditions that confront the soldier.

**Responsibility of the Medical Officer.**—The Medical Department has a well defined responsibility for the well fed soldier. Officers of the Medical Department (1) pass on the animal products—meat, milk and so on—at the time of purchase and issue (Veterinary Corps officers), and of all other products where there is a danger that they may be unsatisfactory or injurious to health; (2) inspect the sanitary conditions of the mess halls and their surroundings and the proper washing of dishes and eating utensils; (3) examine the kitchen personnel to see that they are healthy and will not transmit disease; (4) inspect the selection, preparation and service of food and the disposal of garbage to see that the soldier receives and eats an adequate diet. Where unsatisfactory conditions are found he makes suitable recommendations for their correction.



chased. On the other hand, an adequate, satisfactory dietary is attainable at moderate cost, and excessive expenditure does not always supply an adequate diet. It is highly important that readily interpretable records of nutritional adequacy as well as properly audited accounts of the cost of the soldier's dietary be available. The additional labor involved may be almost negligible.

**Procurement.**—The problems of obtaining the ingredients for an adequate satisfactory dietary for the armed forces ordinarily present little difficulty. They concern, largely, the organization necessary for procurement and supply. Where food is abundant and can be transported without interference with other military objectives, its supply, while complex, is comparatively simple. Restrictions in supplies or transportation and facilities for preparation of food introduce certain complications but do not present insuperable difficulties.

**Efficiency of Messing Unit.**—The selection of food, where this has not already been made as in the field ration, its preparation and service are responsibilities of the individual messing unit. In such a unit there are a number of individuals with variable training concerned. These include the Commanding Officer of the unit who carries the final responsibility, the Mess Officer who should be well versed in all problems of messing but who is too often interested chiefly in financial responsibility and discipline, and the Mess Sergeant who is immediately in charge of the operation of the mess in all its phases, including the proper professional performance of the cooks and the personnel necessary to assist the cooks and to serve the food, to wash the dishes (except in the field where each individual washes his personal utensils), and to police the quarters or area in which food is prepared and served.

At times, especially with the field ration, insufficient procurement or inequitable distribution of supplies may occur at the regimental level. This complicates the effectiveness of the individual organization.

Many of the problems of successful feeding of the soldier appear most immediately in the messing organization, usually the company. The success or failure of a mess occurs in the kitchen and mess hall. It is here that knowledge, training, effi-

ciency and attention to detail make for success: and lack of knowledge, poor training and carelessness form the basis of discontent and poor nutrition.

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or improvement. In other words, a medical officer is concerned with the operation of the mess in all respects in which it affects the health and morale of the soldier. He is the trained technical observer of mess operations who anticipates difficulties that may arise due to the exigencies of the situation or to human frailties and takes measures to prevent them.

**Adequate Nutrition.**—Problems of sanitation are well cared for by regulations. The newer knowledge of nutrition and the realization of the possibilities for good health and morale through adequate nutrition as well as for partial nutritional deficiencies or lowered morale on inadequate diets brings to the front new problems which challenge our thinking. The quantity of food is no longer the major consideration. The proper selection of food, and the retention of nutritive values up to the time the soldier actually eats the food become matters of great importance. Improper methods of preparing food, especially overheating or prolonged soaking, the acidity or alkalinity reaction of the food at the time it is cooked, exposure to the air during cooking or long standing after the food is prepared (oxidation), the retention or use of the cooking water of vegetables and fruits which contains considerable quantities of water-soluble vitamins and minerals, all modify the inherent nutritive value of the food before it is consumed. While the average man thinks, eats and enjoys his meals in terms of food or combinations of foods, the ultimate purpose of eating is to obtain sufficient nutrients. It is desirable to allow us to continue to enjoy our meals, but it is equally necessary for someone to see that the nutritive values that should be present are retained. In the Army this function belongs to the procurement authorities and the mess personnel.

The soldier may eat apple pie and cheese, but from a nutritional standpoint they should contribute vitamin C, the B complex, calcium and energy. However, if the apples are of a variety that is low in vitamin C, and are cooked too much, the pie is only a pleasure as far as vitamin C and vitamin B<sub>1</sub> are concerned. Likewise, with canned spinach. In the canning of spinach a considerable amount of vitamin C, the B complex and carotene, the precursor of vitamin A, are contained, partly in the spinach itself and a considerable part in the liquor,

especially the water-soluble vitamins C and B<sub>1</sub>. If now the spinach is opened and cooked in an open kettle for some time and then allowed to stand for an hour or two exposed to the air and the liquid is thrown away, a considerable quantity of the vitamins C and B<sub>1</sub> and of the minerals is lost. The question then arises: If the men are not particularly fond of spinach and it does not perform its ultimate function, why serve it?

The *selection of foods* presents a multitude of problems. There are many different ways of obtaining an adequate diet as is attested by the variety of food habits that have persisted. We are accustomed to following patterns in selecting foods that have, by experience, proved fairly successful. This does not mean that such patterns are infallible nor that it is impossible to obtain an adequate diet in another way. It does mean, however, that to digress from the proved pattern requires a knowledge of the nutritive requirements of the individual and of the foods in the original diet as well as the new one—a fund of knowledge that not many of us possess off-hand.

An examination of diets and of foods has shown that in many dietaries certain kinds of foods are the major sources of particular kinds of nutrients. It is possible, then, by classifying foods according to nutritive value or because they make a unique contribution to the diet, to obtain information as to the average quantities of each class of food used or required to plan good dietaries, and to make a ready approximate analysis of the adequacy of the food supplied. If the dietary is to remain adequate when dietary habits differ from the average or special conditions of supply arise, it is necessary to know what changes are required in one or more classes of food when a particular class is reduced or increased in amount. This knowledge of food requirements, combined with information on how the food was prepared and served and the quantity eaten, can be used to form the basis for recommendations for dietary operations.

The following material\* has proved of assistance in examining dietaries and making recommendations for their improvement.

\* Taken from mimeographed material prepared in the Office of The Surgeon General

## FOOD AND ITS CONSTITUENTS

The essential nutrients may be grouped under the headings of (1) sources of energy, especially carbohydrates and fats; (2) proteins; (3) minerals, including salt; (4) vitamins; and (5) water. All of these are found in natural foods in sufficient quantities to provide adequately for the nourishment of the body if such foods are properly selected and combined.

Food is the source of the nutrients necessary for life and health. Processed foods have usually lost a part of their original nutritive value, and additional losses may occur in storage and in preparation for the table. Some foods are better sources of certain nutrients than others. However, certain foods, though relatively low in a particular constituent, are eaten in such quantities that they become its major source in the diet.

We usually think in terms of foods and combinations of foods as they occur in our daily diet. When it is necessary to deviate from an accepted pattern it is important and necessary to know the nutrients supplied by the foods omitted and substituted and how necessary supplementary nutrients, especially minerals and vitamins, may be obtained.

**Energy.**—A certain quantity of energy is required in the process of existence—measured roughly as basal metabolism. Any muscular activity above that needed for life processes or exposure to cold requires additional energy. Energy is usually expressed as standard units of heat, *calories*. In round numbers, the energy values of the chief energy-yielding constituents of food are, for carbohydrates and proteins, 4 calories per gram; for fats, 9 calories per gram. (There are approximately 28 grams in an ounce.) The average man at light work requires approximately 3000 calories, while one at hard work requires about 4000 calories a day.

The body obtains the energy required for activity and warmth from carbohydrates, fats and proteins present in food. The major and most economical *sources* are carbohydrates, present chiefly in starches and sugars in bread, cereals, and starchy vegetables; and fats in animal foods such as meat, eggs, milk, butter, lard; in nuts and in vegetable fats such as cottonseed, corn or olive oil, and in the hardened vegetable fats.

**Protein.**—Protein must be included in the diet in order to build and repair muscle and other tissues and to replace proteins broken down in the ordinary processes of existence. The value of protein varies with its amino acid content. Animal proteins generally contain a better distribution of amino acids than the vegetable proteins. Some animal protein may be necessary to supply all the needed amino acids. The average protein requirement for an adult man is 90 gm. per day.

The usual *sources* of protein are lean meat, milk, eggs, cheese, fish and poultry. Good sources of vegetable protein are cereal grains, nuts, soya beans, beans, peanuts and other legumes. These in general supply protein less valuable for growth, but useful for supplementing the proteins from animal sources.

**Minerals.**—The proper development of bones, teeth, muscles, nerves and blood requires certain mineral salts. The average diet is most commonly deficient in calcium, and in some regions iron and iodine. Salt is necessary at all times. Where excessive perspiration occurs, additional salt is needed (see under the discussion of Water). The average requirements for an adult man for certain minerals are: calcium and phosphorus .80 gm. each; iron .012 gm. daily.

Milk (fresh, evaporated and dried) and cheese are the best sources of calcium. Green vegetables and dried legumes are good sources of calcium.

Lean meats, especially the liver, kidney and heart, egg yolk and whole grain cereals are good sources of phosphorus and iron, and dried fruits and potatoes are good sources of iron. The leafy vegetables and meat, in the quantities eaten, are important sources of iron.

Fruits and vegetables in general are a source of certain minerals. (*Note:* Considerable losses of minerals occur in the water used in cooking, hence steaming, or the use of the cooking water in soups and the like, is desirable.)

**Vitamins.**—These are essential for growth and health. Each vitamin performs special functions in the body. In their absence nutritional diseases may occur.

**VITAMIN A.**—Vitamin A keeps the epithelial cells healthy and thus protects against bacterial infection. Early deficiency

causes night blindness. More marked deficiency causes a drying and scaliness of the skin. Deficiency lowers resistance to infection, especially of the eyes, leading to a disease known as xerophthalmia and to infections of the ears and respiratory tract, kidney and bladder stones often develop. The vitamin A requirement has been placed at 5000 International Units daily. For military purposes it is believed this value should be at least 6000 International Units. Where the major portion comes from animal sources as vitamin A it may be slightly less.

TABLE 1

TENTATIVE DAILY ALLOWANCE OF SPECIFIC NUTRIENTS FOR THE AVERAGE MAN  
WEIGHING 70 KILOGRAMS (154 POUNDS)

(Recommended by the Committee on Food and Nutrition of the National Research Council)

Nutrient	Unit of Measurement	Moderately Active	Very Active	Sedentary
<i>Calories</i>		3000	4500	2500
Protein	Grams	70 0	70 0	70 0
Calcium	Grams	0 8	0 8	0 8
Iron.	Grams	0 012	0 012	0 012
Vitamin A	Int. Units	5000	5000	5000
Thiamin (Vitamin B <sub>1</sub> )	Milligrams	1 8	2 3	1 5
Ascorbic acid (Vitamin C)	Milligrams	75 0	75 0	75 0
Riboflavin (Vitamin B <sub>2</sub> )	Milligrams	2 7	3 3	2 2
Nicotinic acid . . . . .	Milligrams	18 0	23 0	15 0
Vitamin D..	Int. Units	400*	400*	400*

\* Where not exposed to sunshine, probable figures

Vitamin A is found in some fats and oils and in the yellow and green vegetables and some fruits. Good *sources* are cream, butter, cheese, egg yolk, liver, tomatoes, green leafy vegetables and yellow vegetables. Vitamin A, or carotene, its precursor, is destroyed by oxidation and the destruction is accelerated by heat. When not protected from oxygen, progressive loss takes place on storage.

VITAMIN B<sub>1</sub> (*Thiamin*).—Deficiency of this vitamin causes changes in the nervous system resulting in peripheral neuritis or beriberi, loss of appetite and interference with digestion. The daily requirement has been set at 60 micrograms per 100 calories—a liberal allowance.

Good *sources* are whole grain cereals, dried beans, peas, peanuts, pork and liver. If the supply of these foods is limited, dried yeast should be taken. In complete absence of these foods three tablespoonfuls of dried brewer's yeast daily will meet the vitamin B needs. Vitamin B<sub>1</sub> is soluble in water. If foods are cooked in a considerable quantity of water which is thrown away, part of the vitamin B<sub>1</sub> is lost.

Thiamin is destroyed by heat, oxygen and alkali. The losses in meats are in the neighborhood of 40 per cent, of vegetables 20 per cent and in the water used in cooking, when discarded, 25 per cent more.

VITAMIN B<sub>2</sub> OR G (*Riboflavin*).—A deficiency of vitamin B<sub>2</sub> causes seborrheic dermatitis and interstitial keratitis which causes partial blindness through the production of opacities of the cornea of the eye. The requirement for the best health has been placed at 3 mg. per day. The desirable ratio of riboflavin to thiamin is 3 parts to 2.

The best *sources* are liver, milk, egg yolk, dried yeast and green, leafy vegetables. Riboflavin is destroyed by heat and exposure to sunlight. It is leached out in water.

NICOTINIC ACID (*Pellagra-preventive Factor*).—A deficiency in nicotinic acid results in pellagra. Early symptoms may be a red tongue or ulcerations in the mouth which are easily mistaken for trench mouth. This may or may not be accompanied by digestive upsets and mental depression. The nicotinic acid requirement has been placed at 20 mg. per man per day. The ratio of nicotinic acid to thiamin has been suggested as 8 to 10 of nicotinic acid or its amide to 1 of thiamin.

Good *sources* of nicotinic acid are lean meats of all kinds, liver, fish, wheat germ, leafy green vegetables, and dried yeast. It is to be noted that dried yeast is the richest natural source of the B vitamins (B<sub>1</sub>, B<sub>2</sub>, and nicotinic acid). Nicotinic acid is relatively stable but is leached out by water.

VITAMIN C (*Ascorbic Acid*).—A deficiency in ascorbic acid causes scurvy which may manifest itself early by swollen gums which bleed easily, defective teeth, weakened capillaries, poor bone knitting, tender joints, and lessened resistance to infection. The vitamin C requirement has been placed at 75 mg. per man per day.



Excellent *sources* are fresh or canned citrus fruits, tomatoes, or tomato juice, and cabbage. Other sources are fresh or canned fruits and berries, and leafy vegetables. Ascorbic acid is lost in vegetables on storage, dissolved out by water as in cooking, destroyed on exposure to the air (oxidation), and in the presence of alkali. (It is the acid reaction of tomatoes and citrus fruits which preserves the vitamin C in these foods.) To conserve ascorbic acid, food should be cooked for as short a time as possible and then served as soon thereafter as possible. The losses in preparation of food are approximately one third of the original content.

**VITAMIN D.**—Vitamin D produces an efficient utilization of the bone- and tooth-building elements, calcium and phosphorus. It is especially effective when the supply or proportion of these elements is inadequate. The vitamin D requirement of man is uncertain—400 International Units per day should be adequate where needed.

Good *sources* of vitamin D are sunshine, fish liver oils and, to a lesser extent, cream, butter, eggs, liver and some kinds of fish. Exposure to sunshine produces vitamin D in the skin and reduces the need for it in the food.

**VITAMIN K.**—Vitamin K is concerned with the formation and elaboration of prothrombin, one of the factors in the coagulation of blood. Excellent sources of vitamin K are the green, leafy vegetables. Tomatoes and hog liver are good *sources*. In normal persons much vitamin K is synthesized by micro-organisms in the large intestines and absorbed in the blood.

**OTHER VITAMINS.**—All of the vitamins named can be obtained either in synthetic form or as potent concentrates if natural sources are not available. If natural food sources of these vitamins are used, it is not necessary to be concerned about others.

**Water.**—The presence of water is necessary to help the main functions of the body, the normal activity of the intestines, the elimination of waste products and the control of the body temperature. It is necessary that more water be taken in the summer and in occupations involving exposure to heat. In this connection it is essential that ordinary table salt or sodium chloride be taken in increased quantities. Heat exhaustion is

due to a loss of salt by profuse perspiration. All water should be potable. It may be chlorinated or boiled when required.

**Bulk.**—Where there is an excess of refined food, with the consequent lack of sufficient bulk, it may be necessary to insure the presence of foods high in cellulose that have sufficient residue to stimulate intestinal movement.

### PLANNING AN ADEQUATE DIET

The following comments apply to the selection of an adequate diet from available foods.

A *menu* is a planned list of foods or methods of preparation to be served at a given time, one meal, a full day, week or month. It is an index of the adequacy or balance of the dietary but it is not sufficient unless the quantities of food supplied and consumed are known. In the Army a menu should be a careful plan for the serving and preparation of food as to its nutritional and satisfying aspects, accompanied by the quantities of food used in connection with it.

The diet outlined subsequently is a rough plan in accordance with present American standards. It is recognized that people may exist indefinitely on a diet having less variety than this. A reduction in any of the categories listed, unless proper adjustments are made in the quantities of other foods, may result in the development of mild and unrecognized symptoms of deficiency diseases or a failure to attain the best degree of efficiency and health of adults.

An adequate diet for an adult may be approximated by including each day:

*Milk*—1 pint of fluid milk, or its equivalent

*Leafy, green, or yellow vegetables*—1 or more servings.

*Tomatoes, oranges, grapefruit or cabbage*—1 or more servings.

*Potatoes, other vegetables or fruits*—2 or more servings.

*Eggs*—1

*Lean meat, poultry, or fish*—1 or more servings.

*Cereals or bread, fats, and sweets*—as needed to satisfy the appetite

At least part of the cereals or bread should be lightly milled or whole grain.

*Water*—6 or more glasses

It is preferable to have one raw vegetable and one serving of raw fruit daily. However, in areas in which cholera and

dysentery may occur the usual precautions about the use of raw food must be observed.

If available, one serving of fruit should be citrus fruit, or tomatoes, fresh or canned. If endemic goiter is prevalent, iodized salt or other recommended source of iodine should be given.

**Classification of Foods.**—Foods may be classified roughly according to their composition, because they are unique or because they are otherwise particularly valuable in the diet. Such a classification aids in analyzing the adequacy of diets when they are considered from the point of view of their use as a major source of particular nutrients, such as the animal foods as sources of good quality protein; milk or its products as a major source of calcium; the leafy green or yellow vegetables important for carotene, the precursor of vitamin A; meats, cereals and potatoes as contributors of the B vitamins; and tomatoes and citrus fruits as sources of vitamin C.

#### FOOD REQUIREMENTS—CLASSIFIED DIETARY

The quantities indicated after each class of food represent average amounts used by an active man in a day when receiving a liberal diet. They do not need to be taken in the amounts indicated each day so long as they are attained over a reasonable period of time. Other quantities will be satisfactory or a class may be entirely omitted, when required, provided adjustments are made in the other foods. Marked deviations from these quantities or classes of food and additional quantities of food for active troops require special consideration to assure an adequate diet. Suggested modifications for active troops are indicated in the analysis of diets.

##### **Meats, Poultry and Fish (12 ounces)**

These supply good protein and are valuable as sources of iron, phosphorus and other minerals, and vitamin B<sub>1</sub> (thiamin) and nicotinic acid. Liver, kidney, and heart are richer in iron and vitamins than muscle meat and should be used frequently.

Fish may be used fresh, dried, salted, or canned. If meats, fish, or poultry are not available, serve eggs, cheese, beans, and peas.

##### **Eggs (1 egg or 0.5 ounce dried whole egg)**

Eggs are next to milk in nutritional importance. They are valuable sources of good protein, iron, vitamin A and riboflavin (vitamin G or B<sub>2</sub>). If fresh eggs are not available, use dried, whole eggs.

##### **Milk (the equivalent of 1 pint, approximately 1 pound)**

Milk contains a variety of nutrient substances, and it is very difficult to construct a diet adequate in calcium without some form of milk or cheese.

Raw milk should never be used. Unless you are absolutely sure that the milk has been adequately pasteurized and properly handled to prevent contamination after pasteurization, all fluid milk should be brought to a boil before using.

*Canned Evaporated Milk* is sterile and when diluted with an equal quantity of water has approximately the same nutritive value as fluid milk. (The water should be boiled and cooled when used to dilute evaporated milk to be used as a beverage.)

*Dried Milk* may also be used. One pound of dried skim milk plus one-half pound of butter is the approximate nutritional equivalent of five quarts of fluid whole milk.

*Cheese* may be counted as part of the milk allowance. Five ounces of American cheddar or other hard cheese is almost equivalent in food value to one quart of milk.

If milk is not available, an adequate supply of calcium should be assured by an increased consumption of green, leafy vegetables, beans and, if necessary, calcium (lime) salts.

(NOTE: Cream soups are very desirable because of the added milk and may be made of almost any vegetable. Cook the vegetables until tender in a small amount of water. Use this water and rub the vegetable pulp through a sieve, combine with hot milk thickened with flour, season and serve hot.)

In adjusting milk products it is necessary to convert evaporated milk, dried milk and cheese to a common basis, *i.e.*, fluid milk equivalent. For this purpose multiply the weight of evaporated milk by 2, dried milk by 8, and cheese by 7.

#### Fats (2.5 ounces)

Fats are concentrated sources of energy. Butter produced when cows are eating fresh green food, commonly called "summer butter," is an excellent source of vitamin A. If butter is not available, a butter substitute fortified with vitamin A is to be preferred. Otherwise any edible fat or oil may be used, but it is then especially important to secure an adequate intake of whole milk or leafy green and yellow vegetables.

#### Bread, Flour and Cereals (8 ounces)

Cereals and breads are most important as sources of energy and vegetable protein and may be consumed in any quantity to satisfy the appetite, provided other nutritional requirements are first met. The less refined the cereal the better its mineral and vitamin content. Whole grain products (such as rolled oats, cracked wheat, whole wheat, rye and corn meal) are one of the good sources of the daily requirements of vitamin B<sub>1</sub>, while white bread contains very little. Whole grain products are not so essential if the diet contains an abundance of vegetables, fruits, milk and meat. White flour is being indicated because of its keeping qualities.

#### Dried Beans, Peas, and Other Legumes (0.5 ounces)

These contain protein, a moderate amount of calcium and vitamin B<sub>1</sub> and may be used as the main dish several times a week. It is not necessary to use the quantity mentioned each day. They may be used in larger quantities at irregular intervals. Because of their tough outer skin, legumes sometimes cause indigestion. This difficulty may be avoided by rubbing the cooked beans or peas through a sieve.

**Sugar (4 ounces)**

Pure sugars do not contribute anything but energy. Heavily sweetened foods should be taken only at the end of a meal; otherwise, they dull the appetite for more nutritious foods. Crude sugars, such as molasses and sorghum, supply some minerals as well as energy, and are therefore to be preferred.

**Leafy Green and Yellow Vegetables (7 ounces)**

These are necessary for their minerals, vitamins (especially carotene, pro-vitamin A) and for bulk which has a laxative value.

If there is no danger of cholera, dysentery, typhoid, etc., raw vegetables and fruits are desirable. Cabbage, carrots, turnips and onions are usually available and may be used raw in salads, especially as a source of vitamin C.

(NOTE: Fresh vegetables should be cooked in a minimum amount of water and only long enough to soften the fiber. Vitamin and mineral loss is reduced to a minimum when vegetables are steamed. It is preferable to cook vegetables with the skins on. Soda should not be added since this destroys all of the vitamin C. Juices drawn out in cooking or water added in cooking contain valuable nutrients and should not be discarded. Properly canned vegetables are about the equivalent, nutritionally, to freshly cooked vegetables. In this case, also, the liquid should be used.)

**Tomatoes and Citrus Fruits (5 ounces)**

These are especially valuable, fresh, cooked or canned, because of their high vitamin C content and should be eaten every day. Cabbage and turnips are also good sources of this vitamin.

**Potatoes (8 ounces)**

Potatoes are especially valuable because they are usually available in large quantities, inexpensive, and can be eaten day after day. They supply iron and in the quantities usually consumed a major source of vitamins B<sub>1</sub>, B<sub>2</sub> and C. If potatoes are not available, substitute 2 ounces of cereals and increase the intake of other vegetables.

**Other Vegetables (8 ounces)**

Other vegetables add to the vitamin and mineral content of the diet, and provide bulk.

**Fruits (canned and fresh, 8 ounces, dried, 1 ounce)**

Fruits have roughly the same nutritive value as the root vegetables. Berries of all kinds, cherries, apples, peaches, pears and melons add to the vitamin and mineral content of the diet. If fresh fruits and vegetables are not available, properly canned or dried fruits may be substituted. Dried prunes, apricots, peaches, apples, raisins and dates may be used but they have lost some of their vitamins.

**Coffee, Tea, Chocolate, Beverages**

These have no nutritive value in themselves.

**Diet Fortifications and Concentrates**

Debittered dried *brewer's yeast* powder to meet certain vitamin requirements when the intake of meats and legumes is deficient may occasionally be ordered by a medical officer.

(NOTE: Dried yeast is not soluble in water. It may be stirred into milk, tomato juice, eggnog, or mixed with peanut butter. However, it settles quickly.

and hence must be taken promptly after mixing. In order to avoid lumping, the liquid should be added to the yeast while stirring. It may also be sprinkled on cooked cereals, mashed potatoes, and the like. However, since dried yeast is not always palatable it is better not to spoil the flavor of the total food, but to take the yeast as a medicine mixed with a small amount of food.)

**Provision for Extra Activity and Data on Nutritive Values.**—The data in Table 2 in terms of pounds, and also ounces, on quantities of food and their approximate nutritive value refer to the "Classified Food Allowance" and to additional quantities of food to supply extra energy for more active troops. In the latter case italicizing of the figures represents a change.

TABLE 2  
CLASSIFIED FOOD ALLOWANCE  
(Expressed as Pounds, also Ounces, per Man per Day)

Food	Moderate Activity		Active Troops	
	Pounds	Ounces	Pounds	Ounces
Meats	75	12	1 00	16
Eggs	125	2	125	2
Milk (fluid equivalent)	1 00	16	1 00	16
Butter	10	1 6	125	2
Other fats	056	0 9	075	1 2
Grain products, cereals	50	8	88	14
Beans, etc., including peanut butter	031	0 5	10	1 6
Sugars and syrups	25	4	25	4
Leafy, green and yellow vegetables	435	7	435	7
Tomatoes and citrus fruits	313	5	20	3 2
Potatoes	50	8	90	14 4
Other vegetables	50	8	50	8
Other fruits, fresh and canned	50	8	30	4 8
Fruits, dried				
(Dried $\times 4$ = fresh)				

Additional energy (calories) has been provided for more active troops in such a way as to increase the energy content without disturbing the nutritive value in other respects, and at the same time permit a selection of individual foods at approximately the same cost. Increases were made, with the exception of meat, in the less expensive foods that yield energy,

vitamins and minerals. Decreases were made in citrus and other fruits. The increase in meat was made for added palatability, not because more protein was required. Adjustments in cost may include the greater use of dried skimmed or evaporated milk and cheese in place of fluid milk, a reduction in eggs, provided most of the eggs are used in cooked dishes, further increases in potatoes at the expense of fruits and additional use of whole cereals and flour in place of prepared cereals.

Any further increase in caloric value will usually be in the cereal (including bread) or bean (including peanut butter)

TABLE 3

APPROXIMATE DISTRIBUTION OF NUTRIENTS IN RATIONS GIVEN IN TABLE 2

Nutrient	Unit of Measurement	Moderate Activity	Active Troops
<i>Calories</i>		3,440	4,680
Protein	Grams	118 0	154.0
Fat	Grams	146 0	192.0
Carbohydrates	Grams	412 0	570 0
Calcium	Grams	1 0	1 1
Phosphorus	Grams	1 8	2.5
Iron	Grams	0 02	0 03
Vitamins			
A	Int Units	11,980	11,900
B <sub>1</sub> (thiamin)	Milligrams	2 4	3 4
C	Milligrams	106 0	104 0
B <sub>2</sub> (riboflavin)	Milligrams	3 1	3 6

components. Fats may also be increased but *most messes* will not actually consume a total of butter or oleomargarine and cooking fat much above 0.15 pound per man per day. Additional fat is often used in deep fat frying, much of which is not eaten and therefore is not in effect food. Additional fat is tolerated in cold climates.

The suggested quantities of fruits and vegetables are liberal. However, with regard to very active troops where the caloric content of the diet must be increased, it may be necessary to choose selectively smaller amounts of those fruits and vegetables of high vitamin potency, eliminating those of lower potency in favor of energy producing foods.

**Compensating for Deficiencies in Particular Classes of Food.**—An analysis of a dietary by means of the classification outlined involves the grouping of the various foods supplied for a week or month into the classes indicated, the reduction of the quantities for each group to a per man, or 100 men, basis and comparison with the quantities suggested. Where deviations occur it is necessary to consider to what extent the nutrients involved in a deficiency in one class may be compensated by an increase in another class. For example, a lowered intake of milk products will affect particularly the calcium, riboflavin and protein content of the diet. An increase in meat will care for the protein and part of the riboflavin; additional green leafy vegetables and beans will help to increase the riboflavin and add calcium. The root vegetables and fruits are roughly similar in nutritive value, hence, a decrease in fruits may be compensated by an increase in potatoes or other vegetables. Wherever the quantity of leafy green or yellow vegetables is lower than usual, thus throwing doubt on adequacy with regard to vitamin A, it is necessary to estimate whether or not this level of vitamin A has, on the other hand, been supplemented, for example, by the use of appreciable quantities of sweet potatoes, or if the quantity of leafy green or yellow vegetables while in itself somewhat low still has incorporated in it a rather frequent use of carrots. Both butter and eggs, while not normally used in large quantities, are still capable of contributing fair quantities of vitamin A.

Thus it is seen that no absolute quantities of any class of food can be set up, but that the diet must be evaluated on the whole rather than as a series of component units. Marked deviations may necessitated the calculation of nutritive values using published tables. With experience it is possible rapidly to evaluate dietaries by this procedure not only with regard to approximate nutritive values but also its acceptability.





## PSYCHIATRIC ASPECTS OF MILITARY MEDICINE

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PSYCHIATRIC aspects of military medicine are somewhat broader than the facts which pertain to psychiatric illness in the men who comprise the fighting forces engaged in war. Lessons learned in World War I, and particularly information at hand from accounts of the change in warfare as demonstrated since September, 1939, open new horizons for study. In order to meet these rapid and recent changes it is appropriate to discuss this field very broadly. To do this, we must include some consideration of the psychiatric aspects of prevention through the proper selection of fighting men, and the relation of war or total defense in terms of civilian life, as well as the usual description of the clinical problems found in the active fighting units.

**Changing Concepts of War.**—The conduct of war is no longer banding together large forces of men who are physically able to carry on combat. The combat zone now reaches into the factory, the farm, the home and throughout the community. The conduct of war may be impeded by inefficiency at home just as seriously as in a front line. The active fighting units no longer may depend on gross manpower and equipment. They are now functioning as groups of specialists in warfare—fast-moving, highly trained, technical integrated teams pyramided one on the other. The mental status of each individual making up such a team is now as important as his physical status. We are now concerned with *total* defense—defense at home as well as at the front. Emphasis now must be laid on the selection of men for jobs at home or in the military service, wherever they may be of the utmost value for defense. Furthermore, total de-

fense includes keeping men where they will not break down mentally or physically.

**Prevalence of Psychiatric Disability; World War I Experience.**—Reasons for a change of emphasis are manifold. Some of them are contained in lessons learned from experience acquired in the World War. Certain figures taken from Volume X, "The Medical Department of the United States Army in the World War" are noteworthy. Admissions of officers and enlisted men from April, 1917, to December, 1919, for observation or treatment of neuropsychiatric conditions numbered 97,657. Discharges of the same numbered 41,976. The number of rejections (neuropsychiatric) by Local Boards in different States reached the total of 549,099.

The Provost Marshal's report, covering only the period of February, 1918, to October, 1918 (nine months), states that because of mental deficiency and nervous and mental disorders, rejections by local draft boards and Camp Surgeons amounted to 48,242. Furthermore, 13,612 men were accepted by Local Boards but rejected by Camp Surgeons. There were 9268 more discharged from the Army after acceptance by Local Boards and Camp Surgeons. More than 8000 soldiers with neuropsychiatric disorders, mostly psychoses, were returned from overseas prior to June, 1919.

A psychiatrist spotted one mentally ill man practically at the gangplank during one embarkation. It was too late to hold him; he was taken to France in charge of two soldiers, kept there pending proper procedures, and finally returned in charge of two soldiers. No one knows the countless similar problems faced by the armed services, and the injustices to the soldier.

Eternal vigilance on the part of the examining physician is the only defense we have against these appalling figures. The careful screen of the psychiatric examination is the preventive and cure of this problem.

**Costs.**—Naturally, a large proportion of the psychiatric disabilities in the Army landed in the lap of the Veterans Administration. During its seventeen years of existence, from 1923 to 1940, it paid out to claimants of disabilities of the nervous system alone the sum of \$641,857,704. For the fiscal year 1940 payments to 68,727 neuropsychiatric claimants amounted to

\$41,889,563. These claimants were 20 per cent of the total number of beneficiaries of the Veterans Administration. Any disability, if manifested before January 1, 1925, can be classified as service connected. There is a presumption of soundness at time of enlistment "unless recorded otherwise by the examining physician at time of enlistment." No one begrudges the rightful care and treatment of men incurring disabilities in the service, but physicians are responsible for some injustice to the taxpayers of the nation if due care is not exercised in eliminating individuals who show signs of neuropsychiatric disorder prior to induction in the service.

More figures make the picture worse. In 1939 there were 11,000 men classed as permanently disabled, and over half of these were neuropsychiatric cases—mostly psychotic. They are receiving \$700,000 a month pensions and disability payments ranging from \$150 to \$175 per month.

The hospital treatment of neuropsychiatric disorders in veterans, from 1933 to 1940 inclusive, cost \$282,679,990. If to this sum is added the figure representing the disbursements of the Veterans Administration to neuropsychiatric claimants from 1923 to 1940 (\$641,857,704), the result is a grand total of \$924,537,613—practically a billion dollars.

These costs do not include the expenses of domiciliary care, national homes for disabled soldiers, and so on.

One serious angle of this situation is the fact that neuropsychiatric cases have a slow turnover and "freeze" Veterans Administration hospital beds. In June, 1940, there were twenty-seven veterans' mental hospitals handling 33,000 psychiatric cases, and they have long waiting lists. These cases represent over one half of all the hospital cases.

Finally, it has been estimated that every man in military service who incurs a psychiatric disability will cost the Government between \$30,000 to \$34,000 during his lifetime. In civilian life or State hospital care the figure is approximately \$7000.

#### PREVENTIVE ASPECTS OF PSYCHIATRY AS APPLIED TO THE SELECTION OF MEN FOR MILITARY SERVICE

These facts and figures from the World War and the Veterans Administration cannot be lightly dismissed. As would be

expected, the Selective Service of 1941 now calls attention and study to these same problems with the hope that all may profit from previous experience. Physicians are now asked to aid in improving the selection of men, as a contribution to national defense. Dr. Clarence Dykstra, Former Director of the Selective Service, at a recent Selective Service psychiatric seminar commented significantly regarding this matter:

"The Selective Service is . . . interested in diagnostic problems about heart and lungs and gastro-intestinal systems, the blood, the bones and joints, and everything else that has medical bearing on the suitability of registrants for induction into the Army.

"The work of specialists in these fields, however, is less in need of immediate attention than is that of the psychiatrist. The work of these other specialists, whether for Selective Service or on the Army Induction Board, is much nearer to their routine practice than the work which we ask of the psychiatrist. The psychiatrist ordinarily sees fully developed problems, whether in the hospital for mental disorders, the clinic, or in his own office practice. We have to ask him to orient himself from that type of work to the diagnosis of early or merely potential mental problems. We want him to use his skill to exclude, as far as possible, all those people who would be seriously damaged in their capacity for useful living by the circumstances which they would encounter if they were inducted for military training. We want him to exclude, as far as possible, all those who because of personal peculiarities and deviations would break down in the service or who would have an unfavorable effect upon discipline and morale. And we want him to exclude those who, however well they might do under actual military training, would probably break down when they were returned to civil life.

"This is a large order, we realize. I think you now see why, while we intend to neglect no relevant aspect of medical science, we feel psychiatry is the first in line."

**Screening Procedures.**—The local draft board, with its consulting physician, is the initial screen. It may help in eliminating certain potential misfits. First, by utilization of the information available to the board members and through the

examination of the local physician the most unfit should be rejected. Secondly, those individuals who do contribute to community life even in a small way, but who under greater stress and strain or in a new environment could not adjust, are another group who should not be inducted. Thirdly, certain individuals, psychologically unsuited for a military profession, in which they would become a burden rather than an asset, should be retained at home where they can continue normal useful lives. Perhaps some critical individuals might say that someone is being favored or pampered, and that this is unfair. But no great anxiety should be wasted over giving an occasional man an unjustified possible advantage. The *real* concern must be to give the military service the important advantage of receiving only those who can be trained into smoothly functioning, efficient, well adjusted soldiers.

If doubt arises regarding the status of any selectees, the Local Board or physician may call for the aid of the Medical Advisory Board. If the experienced psychiatric consultant is not available, which may be true in certain localities, there are other sources of help available. Every State hospital staff stands ready to aid in examining those few unusual cases. The Veterans Administration Facility with large hospitals and experienced staff, located in some nearby area, likewise will respond to any request for consultation.

**Types of Psychiatric Disorders.**—What are the conditions and types of problems or personalities which should be looked for in determining suitability of selectees for service? Medical Circular No. 1 (Revised) of the Selective Service presents a very complete outline which is worthy of discussion. The groups listed are intended solely as a practical guide, and physicians should follow them with discretion and judgment, in order not to reject applicants or selectees without adequate and positive diagnostic indications of their unsuitability for active service, since their unwarranted rejection would not only constitute an injustice to the individuals concerned, but would deprive the Government of their service.

This outline will be presented briefly at this point, in connection with the *selection* of men, and repeated later with reference to *symptoms* and *treatment*.

### Group I. Mental Defect or Deficiency (Feeble-mindedness)

Intelligence cannot be precisely estimated, there being no infallible tests. A history of failure in school in the lower grades, an inability to hold jobs or to be properly disciplined, a lack of information or of the ability to learn or reason, and general signs of mental inadequacy are characteristic. The average community knows who these men are and what capacity they possess. Psychometric testing can be used for classification of doubtful cases.

### Group II. Psychopathic Personalities (Constitutional Psychopathic Interior)

These are the individuals who are neither mentally ill nor mentally deficient, but who nevertheless are unable to learn by experience to measure up to ordinary social responsibilities. They are emotionally unstable, undependable, impulsive, always in difficulties, and often in conflict with the law. They cannot be disciplined, will not conform to authority and are constantly cultivating insubordination. Among these are the homosexuals, grotesque liars, vagabonds, wanderers, swindlers, kleptomaniacs, pyromaniacs, alcoholics, irritable and arrogant "guard house lawyers." They are among the worst of the men unsuitable for military service.

It may be true that some psychopaths and morons make good soldiers. Officers of the Army as well as experienced psychiatrists believe, however, that it is impossible to detect what types would turn out satisfactorily.

### Group III. Major Abnormalities of Mood (Manic-depressive Psychoses)

Some people are so mercurial in their reactions that they have episodes of elation or depression in which their judgment is seriously impaired. The more extreme examples are known as manic-depressive psychosis. If they are known to have received medical or nursing care because of an excitement or depression they should be rejected.

## Group IV. Psychoneurotic and Psychosomatic Disorders

Men suffering from hysteria, psychasthenia, anxiety neurosis and anxiety states are clinical psychoneurotics who are usually unsuitable. Their symptoms may be hysterical and not understandable; they may have periods of morbid anxiety or fear; compulsions or obsessions and hypochondriacal states may control much of their lives.

For purposes of classification, there are to be placed in this group persons showing the so-called *psychosomatic disorders*—mental or personality difficulties characterized chiefly by signs and symptoms of systemic disease, whether respiratory, gastro-intestinal, cardiac, genito-urinary, or dermatologic. These include many cases of asthma, urticaria, "neurasthenic states," neurocirculatory asthenia, "effort syndrome" or D. A. H., paroxysmal tachycardia, gastric hyperacidity, pylorospasm, gastric and duodenal ulceration, spastic constipation, and diarrhea, mucous colitis, impotency, urinary urgency or frequency, and incontinence of semen. Look for a clear relationship in the history of attacks coinciding with periods of *personal stress*, and of improvement with separation from the accustomed stressful surroundings. These conditions sometimes appear early in the course of prepsychotic states discussed under Group V.

These are the individuals who, when examined, show marked vasomotor instability, characterized by breathlessness, unstable pulse rate, unstable blood pressure, poor exercise tolerance, tremors, cold, clammy, sweating extremities, all types of sensory complaints and many other signs indicating disturbance in the autonomic nervous system. They do not do well in military service. It is difficult to know who to reject or accept in this group. The best that can be done is to estimate insofar as possible from their history what their capacity may be in meeting stress and strain.

These men may break down in active service and be a problem instead of an asset; but undisturbed in civilian life, their satisfactory adjustment may be maintained, enabling them to keep their self-respect and contribute like others to total defense.



### Group V. Prepsychotic and Postpsychotic Personalities in Schizophrenia (Dementia Praecox)

Prepsychotic and postpsychotic personalities of this dementia praecox (schizophrenic) group usually have a history of an acute or insidious personality change in which their social interests, habits, thought and behavior deteriorate. This change may be shown by attitudes of suspiciousness, ideas of self-importance (paranoid personalities), unusual irritability or inappropriate emotional reactions, extreme seclusiveness, silliness and apparently unmotivated emotional or motor outbursts. These are some of the characteristics of grave mental disease and probably will progress to delusions of persecution, delusions of control by bizarre or supernatural agencies, sexual delusions, hallucinations of sight and hearing, and oddities of thought, speech and behavior that obviously are abnormal psychotic states. In the presence of marked indifference, apathetic emotional reactions and a history of withdrawal from social, family or other environmental contacts, careful study is indicated. A history of the school and vocational careers and of the personal and family life will spot these personalities and conditions.

One such history illustrates a pathetic case. A boy, youngest in his family, grew up as the favored and best loved child. At sixteen, he changed in personality, and tried to become a man by smoking, drinking, reading Kipling and getting gonorrhea. Soon he was showing more malignant personality changes and began to hear the voices of his father and God. On admission to the Army he was reacting more acutely in a paranoid way to his hallucinations. One day he was placed on guard duty over a prisoner in the guard house. Believing the occupant of the guard house was responsible for the accusing voices he heard, he shot the defenseless prisoner dead.

The dangerous undependability of this group may take many avenues of manifestation.

### Group VI. Chronic Inebriety

The hard drinker may not be necessarily a poor soldier, but the chronic alcoholic who is morbidly addicted or dependent on alcohol is of no value in military service. A verified history of frequent breach of the law when drunk or of hospital treatment for alcoholism should be regarded as disqualifying. A

history or signs of drug addiction, or a history of arrest for narcotic law violation, is disqualifying.

### Group VII. Syphilis of the Central Nervous System

Although blood examinations may help in eliminating selectees suffering from syphilis of the central nervous system, there must be careful search for anomalous reactions of the pupils, facial tremors, speech defects, writing defects, apathetic, depressed or euphoric mood, memory loss, and discrepancies in relating facts of personal history. Knee jerks may be normal, or above or below normal. All suspected cases should be referred for full serologic study, including examination of spinal fluid.

### Group VIII. Other Organic Diseases of Brain, Spinal Cord and Peripheral Nerves

Existent organic nervous disease should always disqualify a man for military service. Certain after-effects of organic nervous diseases need not be causes for rejection provided (1) that the disease is no longer operative and is not likely to recur, (2) that the effect left by it does not prevent a satisfactory fulfillment of military duties. Certain *organic nervous diseases* present few symptoms and may pass undetected by even the most skillful examiners. These include multiple sclerosis, progressive muscular atrophies, muscular dystrophies and syringomyelia. *Epilepsy* is particularly troublesome in the service. There may be a history of continued bromide, phenobarbital or dilantin medication. Special investigation into medical history should be pursued in any case having a history of so-called faintness, dizziness, spasms of the face or extremities, or evidence of deep scars on tongue, face, or head.

**Obligations to the Man Himself, and to the Community.**—If at any time doubt arises in the minds of the Local Board or examining physicians regarding the qualifications of a selectee, no effort should be spared to have him given a special examination by the Medical Advisory Board psychiatrist or his equivalent.

Aside from this attitude directed toward the welfare of the service, and the duty of the physician to do his work in accordance with this attitude, there exists a further obligation to the men themselves. The question is not alone one of unfitness for military service; it is also a question of fitness and vocational suitability of a man *as a civilian*. Rejected men are not thrown away—they are retained at their efficiency level for industrial and community life. It may be a venial sin against the national defense to induct a man into the service to which he may be unsuited, to which he cannot adjust and contribute; but it is a mortal sin against the man himself. For in his civilian life, where he is maintaining himself under reasonably favorable conditions, he has his self-respect, he is making a contribution personally or economically, small though it be, and he probably will not become a burden on the community for any long period of time at least. To maintain this balance is as much a duty in terms of public health as in terms of total defense. Physicians who are responsible for the examination and classification of these men find themselves today in the front line trench of defense. The medical profession has a great responsibility and duty in helping to combat this great problem in the proper selection of men.

#### A SHORT PSYCHIATRIC EXAMINATION FOR SELECTEES

The present emergency associated with the induction of men into the Army raises many problems for examining physicians. Fitness for service involves a great deal from a physical standpoint, but the experience of World War I has disclosed that much is involved also from mental and emotional aspects. The examining physicians of the local draft boards are endeavoring to examine the man from all aspects. Some of them have sufficient clinical experience of a character that aids them in spotting the psychiatrically unfit; others may need orientation to help them in this work.

Fifteen minutes is a short time to "size up" any man. It appears that this is about the limit of time which any medical examiner will have to ascertain a man's fitness for induction into the military service. Since that is the time available it necessi-

tates devising an approach to the man which will enable us to estimate as accurately as possible his condition. Submitted herewith is an outline of questioning, which, if used with a psychiatric viewpoint, may help in detecting those who should be referred to the psychiatrist of the Medical Advisory Board for further examination.

The outline of questions, Part I, is not a complete psychiatric examination. It must be used simultaneously with the inspection and observation of the man. For the general practitioner it merely outlines a psychiatric viewpoint and approach. For one with psychiatric experience it may be used as a basis for a more elaborate examination. The answers to the questions are important, but equally or more so are the reactions of the man to the questions, and his attitude. The questions may be asked during the physical examination, during which the general behavior and special objective signs listed in Part II should be noted.

If a history concerning the man's personality, adjustment and background is available to the examining physician the accuracy of this examination will be greatly enhanced. If a history is not available, this outline is a guide to completeness in considering various possibilities of handicaps from disorder or disease. Positive findings are easy to obtain through questioning or objective examination when a psychiatric illness or neurological disorder is obvious or has been disclosed by history. But positive findings in this examination, supported or unsupported by the history, indicate only a lead and suggest the wisdom of calling on the Medical Advisory Board for further detailed study.

### I. Questioning

1. What is your name?

2. How old are you?

The first two questions merely serve as an introductory approach as part of the objective inspection.

3. What work have you been doing and how do you like it?

*Leads:* Adjustment with fellow workers, reaction to authority, attitudes of inferiority or inadequacy, tendencies toward irritability, "chip on the shoulder" reactions, satisfaction in work, general work ability.

4. How far did you go in school?

*Leads:* General intelligence, mental deficiency or retardation

5. What do you like to do for a good time?

*Leads:* Type of friendships, social relationships with both men and

women, general sex adjustment, breadth of interests and activities, tendencies to seclusiveness or peculiarities.

6. Do you have any trouble getting along with people?

*Leads:* General personality outgoing or retiring, cooperative or resistive, friendly or suspicious, quarrelsome and general social maladjustment.

7. What bad habits have you had?

*Leads:* Strength of will, ease of habit formation, ways of combating bad habits, amount of alcoholism, general strength of character.

8. What illnesses have you had?

*Leads:* Effect of serious illness at any special age period, attitude toward illness, tendency to worry about health, general reaction to disease or stress and strain.

9. Did any illness make any change in you?

*Leads:* Chronic weakness or fatigue, worry or fear about body function, tendency to hypochondriasis, neurasthenia.

10. Do you sleep well?

*Leads:* How long it takes to get to sleep, how much sleep is needed, too much sleeping, presence and effect of dreams indicating emotional tension or anxiety as part of neurosis or maladjustment.

11. How often do you get nervous?

*Leads:* How easily are nervous reactions aroused, is the reaction adequate, intermittent or chronic, how it interferes with work or life in general.

12. Have you ever fainted?

*Leads:* Possibility of epilepsy, hysteria, vasomotor instability, strong fear reactions.

13. Have you ever had fits?

*Leads:* Especially epilepsy or hysteria.

14. How often does your heart race or pound?

*Leads:* What makes it do so, how long does it last, how it stops, how much concern is caused, possibility of neurocirculatory asthenia, cardiac neurosis, vasomotor instability, overreaction to fear.

15. How often do you get stomach upsets?

*Leads:* What produces upsets, how long do they last, how do they affect life and work, presence of "mucous colitis," neurasthenia or hypochondriacal states.

16. How often do you get spells of unhappiness or depression?

*Leads:* What causes them, how long do they last, how does he "snap out of it," how do they interfere with work and health, do said feelings control thinking and actions, ideas of suicide, possibility of manic-depressive mental disease.

17. What kinds of fears bother you?

*Leads:* Intensity of fear, causation and means of control, definite fears such as fears of closed or open spaces, crowds and fears of unexpected origin as in anxiety neuroses.

18. Have you ever been paralyzed?

*Leads:* Unusual illness, epilepsy, hysteria.

19. What do you worry about?

*Leads:* General maturity of judgment, free thinking, presence of obsessions or compulsions, marked doubts, method of meeting or handling them.

20. Do your hands sweat easily?

*Leads:* Vasomotor instability, excitability, overreaction to instinctual and emotional drives.

21. What unusual experiences have you had?

*Leads:* Peculiar, eccentric, odd, queer personalities, possible mental disease.

22. Have you ever been treated for a nervous breakdown?

*Lead:* Presence of actual psychoneuroses or mental disease known to patient.

23. Have you ever been admitted to a hospital for nervous or mental disease?

*Leads:* (Same as No. 22.)

## II. Objective Examination

### General Impression

#### *Attitude*

Confusion, embarrassment, evasiveness, suspiciousness.

Reticence, shyness, anxiety, contradiction.

Resentful, antagonistic, overtalkative, inattentive.

#### *Appearance and Attire*

Method of undressing or dressing.

Carelessness, slovenliness, over-niceness, over-preciseness.

Efficiency, unusual mannerisms.

#### *Expression and Speech*

Stammering, stuttering, voice tremors, tics.

Paleness, blushing.

Odd or irrelevant facial expression.

### General Examination

#### *Posture*

Gait.

Romberg sign.

General evidence of increased muscular tensions.

Local or generalized tremors.

#### *Coordination*

Finger to nose; use of hands.

Heel to toe while walking.

#### *Reflexes*

Pupillary.

Knee jerks

#### *Ocular Movements*

Nystagmus; exophthalmos.

#### *Vasomotor*

Transient hypertension, tachycardia.

Excessive sweating, blushing, dermatographia

Clammy hands and feet.

#### *Miscellaneous*

Acne; scars; excoriations, thyroid fullness.

Questions 1, 2, 3, 4, 7, 10, 12, 13, 18, and 20 can be covered usually in a matter of seconds. The other questions may take more time but as a rule less than half of the remaining thirteen

questions will require special development. Probably fifteen of the twenty-three questions could be covered in less than five minutes and simultaneously the examiner would have noted what he wished about *attitude, appearance and attire, expression and speech, vasomotor and miscellaneous matters*. Perhaps ten minutes would remain for a brief neurological examination to include *posture, coordination, reflexes, rough sensory examination* and the development of the remaining questions. When certain answers have a significant connotation further detailed questions would be in order to establish the actual status of the examinee. Each examiner naturally uses his own experience and technic in pursuing detailed questioning to a logical conclusion.

Neurological diseases are not common in the draft age period in individuals who have not had subjective complaints sufficient to warrant special detailed examination. A very small percentage can be picked up by physical examination; and special watchfulness of course is indicated for the epileptics. for the weeding out of whom we are again somewhat dependent on history.

Aside from the neurological examination the emphasis, then, should be on ascertaining the personality, mental and emotional status of the man through questioning.

A simple, personal, conversational approach is best. A common sense judgment is all that is necessary in evaluating the answers if we are aware of the purpose of the examination.

The essentials that we are after are those contained in the picture and knowledge of the man in reference to his *work, his physical health, his nervous health, and his relationship with others*. We should know if he is superior, normal, average, neurotic, feeble-minded, psychopathic, or psychotic. Anyone whom we consider neurotic, feeble-minded, psychopathic, or psychiatric should either be referred to the Medical Advisory Board for examination, or immediately recommended as unfit for service.

These individuals have not shown the ability, through no fault of their own, to adjust in civilian life. We have no reason to believe that their maladjustment would be any *different* in the Army. Some theorists claim that the "Army will make

men out of them." or "the Army will help them get over their troubles." The experience of the Army is definitely to the contrary. Perhaps out of ten men one or two, through new outlets and experiences, make better adjustments in the service than they did in private life, but this does not justify the admittance to the service of the greater number who will simply take along their problems. It is probable that some of these individuals are attaining a certain degree of success in civilian life. Their induction, besides being detrimental to the service itself, prevents these men from making some useful contribution to social welfare. *The Army is not a hospital or a curative agency.* It is an organization that needs qualified, able and efficient workers. It is the duty of every conscientious examining physician to see that these unfit men are not admitted to the service.

Obviously such a procedure as outlined woefully neglects many "scientific" principles of examining men. We could include many special technics of the neurological examination, cardiovascular studies, psychogalvanic measurements, and still other approaches. But such methods can never be utilized within the time limit available, which at present seems to be no more than fifteen minutes per man. The studies of the medical officers of the Army, or the psychiatrist who acts for the Medical Advisory Board, must be depended on for the final survey.

#### DIAGNOSIS AND MANAGEMENT OF PSYCHIATRIC CONDITIONS IN MEN IN ACTIVE SERVICE

In spite of every effort to eliminate before induction those men who are psychologically unable to adjust to military life, a certain percentage will be accepted, and many others, apparently normal, will break under the stress and strain of various aspects of military experience. About 5 per cent of selectees should be eliminated before induction: nearly as many will probably become problems in the service. Not only those predisposed to nervousness or mental instability will break down, but also many who had no history of difficulty prior to induction or who showed any signs of autonomic, physiologic or mental disturbance. The Flanders retreat (Dunkirk) of the British in 1940 resulted in severe breakdowns in many men previously considered to be of reasonably strong,



sound personality background. Experience shows that this may happen under the circumstances where the strain is severe enough. Everything must be done to make the adjustment of the soldier as simple and easy as possible.

**Hazards of the Service.**—There are many types of hazards to which the newly inducted soldier, as well as the veteran front line fighter, are subjected. The first which must be considered, are the *psychological* hazards involved in the early training period. The change in environment, separation from loved ones, anxiety over family responsibilities, strangeness of camp life, change of diet, food, habits and other personal matters, the new restrictions imposed by discipline and lack of personal independence, all are important problems in individual adjustment. They may be easy and of benefit to some, but more likely they are difficult for many, bringing out latent emotional inadequacy or instability, or mental illness previously not activated. If the soldier passes through this period successfully his chances to be of at least average value to the military forces are probably good. But still more factors remain as hazards, not only for those predisposed individuals but for all who are exposed to the rigor of actual war service. These further hazards may be physical or mental. They consist of *fear*—fear of death, of being buried, wounded, or being made prisoner—and of *monotony, food deprivation, fatigue, exhaustion, the noise* of artillery shells, and particularly the noises made by airplanes and bombs. The “strangeness” of the present war tactics may prove to be disturbing if there has been a period of inadequate training. One British observer recently stated, “I am beginning to believe that shell-shock, whatever it may be, can often be explained on the basis of inadequate training.”

It must be admitted that the adjustment of the normal individual is conditioned against the practice of war and killing. Guilt over killing may seriously disturb the personality of many. Social groups may approve the necessity of war and its complications, but the normal personality has to undergo much readjustment to avoid precipitate desire or action to escape in order to evade adjustment to reality under warfare situations. Conflict results, and the psychopathology of conflict situations within normal individuals striving to adjust under abnormal

conditions must be understood and kept in mind if diagnosis and treatment be well executed.

**Principles of Treatment.**—In active service those who are psychiatric problems because of lack of adjustment, or because of actual illness, must be handled according to the practical necessities of time and place. It seems rather ridiculous to discuss management and treatment of psychiatric problems in the light of the type of warfare now described in news dispatches. One can only outline the possibilities of treatment which should be kept in mind. The application of these principles must be worked out according to aptness of opportunity. Essentially, the psychiatric treatment employed in military life and civil life is similar. Certain technics and procedures are necessary for both. Under military conditions experience has demonstrated, however, that patients with acute problems, such as psychotic episodes, must be evacuated to hospitals especially equipped for such work; that the psychoneuroses must be treated early or immediately, and near the point of their origin, if hope for final success is to be maintained. The fancy or special measures of treatment cannot be indulged in at front line stations; they must be reserved for base hospital centers and only emergency or practical substitutes used at the beginning. This does not mean, however, that many special measures cannot be used effectively even in front line stations. The necessary corollary is that medical officers must be psychiatrically oriented or experienced so that diagnosis is early and treatment immediate. If this is not true, and a psychiatric consultant is not available, the casualties will be increased excessively.

Elaboration of the characteristics and management of the various types of psychiatric problems seen within the service will be taken up according to the outline of eight groups already briefly discussed in relation to the selection of men.

#### Group I. Mental Defect or Deficiency (Feeble-mindedness)

There is some disagreement as to the value of mentally deficient men as soldiers. The Army will accept men who have a mental age of nine or ten years, equivalent to about the in-

telligence necessary to pass fourth grade school work. Some officers believe this is too low a level for efficient soldiers, but others feel there is much that can be done with such material. It cannot be denied that many men of this intelligence level have become good soldiers. In modern, fast-moving, technical warfare where machines play such an important part, it is reasonable to believe that they may be of less value and more of a problem than before.

The feeble-minded man has a definite inability to learn rapidly, and obeys orders well only under routine circumstances. Any soldier who continues to be a problem in these matters should be discharged early from any important work in the service. Transfer to a limited type of service may be tried, but it is never possible to know when such a man may be assigned to duty which he is unable to accomplish.

Such an individual reacts under stress and strain of duty beyond his capacity with irritability, insubordination, and behavior outbursts which he cannot control. His threshold of protection from psychotic behavior is low under such circumstances.

TREATMENT obviously is limited to a matter of skillful management by change of duty, protection from responsibility, and assistance in the adjustments of the individual in whatever limited duty he be assigned, by encouragement, suggestion and the simple psychotherapeutic measures which one could use in handling any subnormal individual in civilian life.

Psychotic behavior necessitates immediate evacuation with recommendations for discharge from the service.

## Group II. Psychopathic Personality (Constitutional Psychopathic Inferior)

The psychopathic personality is often a puzzle to himself, and always to those who try to live or work with him. He is not mentally ill except in rare episodes; he is not feeble-minded, yet his behavior is more troublesome than feeble-mindedness to the service at times; and he is incapable of learning from experience. Sometimes the personality is attractive enough, and no evidence of the defect appears, but sooner or later his behavior episodes complicate the environment wherever he may be. The

psychopath is emotionally unstable, undependable, a habitual liar, egocentric, possesses no regard for honesty or consideration for fellow soldiers, does not adjust to group life, often being suspicious, callous, alcoholic, and usually insubordinate.

Homosexual behavior is not uncommon. In the intervals between conflicts with authority there may be apparent cooperation and pleasantness, but as a rule the psychopath is never adaptable to group life and army discipline.

TREATMENT is futile and early elimination from the service is highly desirable for any soldier consistently showing any of these signs and symptoms.

### PRODROMES

The next three groups comprise clinical conditions of very different types. Nevertheless, before actual clinical symptoms of a clear-cut type are obvious, there are often prodromal signs and symptoms which indicate an impending mental or nervous collapse. These prodromes will not indicate what the final condition may be, but are somewhat similar in the initial period. To avoid repetition a few of these significant developments should be discussed prior to separate consideration of the established clinical entities.

*Military misbehavior* may be the first evidence of mounting tension or beginning maladjustment. There may be a gradual but distinct change in the previously existing personality. This may be evidenced by irritability, moodiness, homesickness, frequent reporting at sick call, seclusiveness, lack of initiative and cooperation, loss of appetite, sleeplessness, and periods of anxiety or depression. *Physical manifestations* would include rapid heart action, spells of vomiting, fainting, diarrhea or constipation. More marked *behavior changes* might follow, such as insubordination, crying spells, temper outbursts, sleepwalking, periods of confusion, panic or stupor. Ordinary illness might be prolonged and complicated by unusual manifestations such as delirium, excessive fatigue and sexual disturbances.

These signs and symptoms are warning signals to the enlisted man's associates and medical officer, that serious maladjustment exists. Treatment measures instituted at this time may prevent or at least delay a more serious illness, otherwise

a fully developed clinical problem of a special nature would likely take form shortly.

### Group III. Major Abnormalities of Mood (Manic-Depressive Psychoses)

These conditions are major psychoses and may manifest themselves suddenly without warning or follow certain prodromes. The essential characteristics divide into two main reactions (mood swings), a period of elation and overactivity and one of depression and underactivity.

**Manic Phase.**—The “upswing” is characterized by overtalkativeness, increased physical activity in work or play, marked defects of judgment accompanied by wild delusions of grandeur, importance, ability or power, and an emotional state of well-being, elation, irritability, anger, or extreme excitement. Such a condition becomes nearly unmanageable except under the restrictions of a psychiatric hospital. It tends to persist months rather than weeks, and is in no way to be confused diagnostically with the confused, semidelirious excitement syndromes following prolonged fatigue, food deprivation or exhaustion, which ordinarily respond to treatment in a matter of days.

**TREATMENT**, which is the same as in civilian life, is largely a matter of skillful arrangement, and is possible only in a hospital after evacuation. During the acute attack treatment would consist of the usual medical care in terms of rest, isolation, proper food intake (tube feeding may be necessary because of excitement), and the use of sedatives (paraldehyde 10 cc. to 15 cc. by mouth; 20 cc. by rectum) (sodium amytal 0.3 gm. to 0.6 gm.) continuous baths and cold wet packs. Shock therapies of recent origin are effective in shortening duration of attacks, but as yet are not commonly employed in Army hospitals. Later in the attack or during convalescence occupational therapy, systematic exercise and psychotherapy are important.

**Depressive Phase.**—The “downswing” is often the reverse of the excited state; there is underactivity in interest, conversation and speech, with obvious sadness and marked dejection, and defects in judgment in conjunction with delusions of self-depreciation and self-accusation. The patient be-

lieves he is infecting others, has done them harm, that he is responsible for the wrongs of the world, that his body is diseased, bowels stopped up and that other somatic changes have occurred. The mood is often very despairing and the suicidal risk with such a patient is very great. Like the excited stage this attack persists for months. The depression seen in psychoneuroses or toxic conditions may appear similar, but there are usually few if any fixed delusions, and it responds promptly to treatment.

TREATMENT is similar to that of the excitement in general, except that little sedation is necessary unless the patient is agitated; special attention must be given to proper elimination and general physiologic function, with particular care in regard to full intake of food. Digestive and other functions are markedly retarded in these patients. Benzedrine sulfate, 10 to 15 mg. once or twice early in the day, helps the depression symptomatically. Unlimited watchfulness must be maintained to prevent suicidal attempts.

Fortunately this psychosis is not common in the service. Evacuation is imperative at once. Return to the service is usually inadvisable as the condition is likely to recur, particularly under stress and strain.

#### Group IV. Psychoneurotic and Psychosomatic Disorders

These groups probably present the most important and difficult problems in relation to detection, diagnosis, treatment and disposition of any of the psychiatric conditions found in military medicine. The disorders of these groups might be described as lying in the borderline area between normalcy and mental illness. Even though these conditions may not be considered as malignant insofar as general attitudes are concerned, they are as serious as psychotic reactions, because they may interfere so much with duty, are difficult to classify, and are so much more numerous in number. There are more men with "borderline" conditions than psychoses admitted to the service; and two thirds of those discharged for psychiatric disability are within this group.

An individual who develops a clinical condition within

these groups is usually one who reacts more sharply, sensitively and intensively under the same or less stress and strain than does a "normal." Whether or not this is because of inherent defect, or the result of developmental differences or conditioning, is beside the point.

The resulting tendencies in reaction patterns speak for themselves, and exist as hazards for normal or average adjustment.

The symptoms of these conditions may appear quite suddenly. Usually, however, prodromes would be expected (see discussion preceding Group III). Common ones would be general "nervousness," insomnia, fatigue reactions, unusual but temporary emotional upsets, irritability, lack of interest and initiative, and minor but numerous physical complaints. The quicker such prodromes are recognized the greater is the likelihood that treatment will prevent a psychiatric disability.

**Malingering.**—The problem of the malingerer is exceedingly difficult. It is always difficult to know whether the motivation behind malingering is willful or neurotic. Some psychiatrists believe all malingerers are neurotic. Others point out that many malingerers will make the best of a situation when their attempt to evade duty or escape service is detected, and therefore no serious neurotic maladjustment is present. The medical officer must decide whether the problem is one of conscious, purposeful evasion, or one of a neurotic, possibly unconscious escape mechanism. Such a decision may be in error at times, but it must be made on the observation of the medical officer plus the account of the situation from the line officers, commissioned or noncommissioned, who may be very helpful in giving a common sense version of any difficult situation. The willful malingerer, when detected, must be allowed some means of "saving face" and returning to duty without serious publicity. If this be accomplished he may continue to be of value in the service. The malingerer who is considered neurotic must be studied as a patient and treatment given according to the degree of illness, with discharge from or retention in the service to follow the indications found in such study and treatment. The treatment, of course, would be psychotherapeutic and

would be applied as in any personality maladjustment or psychoneurosis.

### PSYCHONEUROTIC DISORDERS

There are several clinical types, the most important of which are conversion hysteria, obsessive-compulsive states, neurasthenia and anxiety states.

**Conversion Hysteria.**—Conversion hysteria is the commonest war neurosis. It occurs more in the average soldier than in officers; it often comes on abruptly: there is a deeply hidden, unconscious conflict present between the instinct of self-preservation and the forces of idealism. The neurotic outbreak is an attempt to resolve the conflict. Symptoms are manifold, and the condition may simulate nearly anything. Common symptoms are amnesia, aphonia, various degrees of blindness, deafness, paralysis, hemianesthesias, tics and gait disturbances. In striking contrast with some other psychoneuroses, the conversion hysteria often shows a lack of evident emotional disturbance.

If TREATMENT is instituted early the condition may be relieved readily or abruptly by suggestion.

**Obsessive-Compulsive States.**—Obsessions and compulsions tend to appear in those soldiers or officers of the more intellectual types, who often have personalities of a rather exacting, inhibited, precise, systematized, highly organized type. These states may exist for some time without interfering with morale and discipline. Symptoms rather than signs are the rule, as the patient is subjectively bothered by constant and illogical fears—fear of closed spaces, dirt, infection, and of the dark. Some fears more directly connected with the environment are those of being buried, of killing, and being killed. Morbid doubts, repetitious acts and compulsions are another group of symptoms obsessing the mind of the patient, making him carry out rituals of explanation, checking and rechecking, doing endless things to safeguard himself and relieve his anxiety. Many soldiers have been so troubled and still made good records. Intensification of such symptoms would incapacitate them for duty. Many cases are on record in which the actual breakdown



of men with these types of symptoms did not occur until after discharge from the service.

TREATMENT is largely prolonged psychotherapy.

**Neurasthenia.**—Headache, fatigue on either mental or physical activity, no matter how limited, marked weakness in all activity, difficulty of concentration, shortness of breath, marked reaction to temperature changes, backache, frequency of urination, lack of appetite, insomnia and a number of other symptoms which may be attributed to one body system or another, make up the multiplicity of symptoms which may be seen in neurasthenia. The mood is often dejected but responds to stimulation. "Reactive depression" is not uncommon but responds differently to events and treatment than the depression seen in manic-depressive psychosis. Extreme reactions of the neurasthenic type may be close to what is described later in psychosomatic disorders. *Hypochondriasis*, a state in which the patient is constantly complaining of bodily aches, pains, weakness and difficulties in function, accompanied by a fixed belief as to the seriousness of his condition, is a severe and chronic illness which bears some relation to this condition. Exhaustion and fatigue states intensify these symptoms both in intensity and constancy, but respond to medical treatment readily.

TREATMENT is discussed in the outline at the end of this article. Emphasis should be laid on *re-education*, both physical and mental, as part of the organized psychotherapy. Although these patients respond well, there is likely to be a prolonged period before recovery. Since recurrence is common under an unfavorable situation, many of these patients eventually will have to be evacuated or discharged from the service.

**Anxiety States.**—These include "anxiety neurosis," "anxiety states," "anxiety hysteria," and so forth. Such entities are separated on theoretical etiologic bases that are not too well established or important here. They all have in common syndromes characterized by anxiety symptoms which are quite characteristic.

A state of tension, slowly developing, is experienced by the patient. This is usually the result of stresses which may or may not be unusual. As the condition progresses there is an increase

in fatigue, restlessness, insomnia, anxiousness, and loss of appetite. Vague fears and signs of physiologic disturbance such as breathlessness, palpitation, frequency of elimination and uncomfortable cerebral sensations follow. Difficulties in attention and concentration worry the patient. In the severe cases the same symptoms are intensified in attacks of panic, indefinable terror, perspiration, dizziness, fainting and marked tachycardia with various conversion symptoms.

Many types of psychiatric illness may start with such symptoms, and later define themselves in more clear-cut syndromes. But anxiety syndromes of various degrees exist as definite entities and must be treated early and aggressively as such. In an acute state evacuation is imperative since treatment is effective only in a controlled environmental setting. (Details concerning psychotherapy are given in the outline later.)

The following description of "acute war neurosis" by English authors\* might be given a variety of diagnostic labels. But it must be characteristic of what frequently could be expected under active war conditions, whether we call it psychoneurotic, psychosomatic, fatigue and exhaustion state or anything else.

"The clinical picture was surprisingly uniform—signs of physical exhaustion—thin, fallen in face and pallid or sallow complexion. The expression and whole attitude of the body was one either of tension and anxiety or listless apathy—neurological signs of a functional nature were usually present—coarse irregular tremor of the hands—much resemblance to parkinsonism. Mentally patients showed insomnia, nightmares, acute anxiety and tendency to start at any noise or sound, particularly those resembling the sound of an airplane.

"Treatment by sleep, rest and proper food produces quick even results. Rest in bed, the use of hypnotics, full food and liquid requirements were important. Continuous narcosis for the patients most affected, was of help. Acute hysterical symptoms were treated by persuasion, hypnosis and the use of intravenous barbiturates."

\* Sargant, W. and Slater, E.: *Lancet*, 2: 1-5 (July 6) 1940. Quoted from *The Neuroses in War*, Emanuel Miller, Editor. By permission of The Macmillan Company, publishers.

## PSYCHOSOMATIC DISORDERS\*

Psychosomatic disorders make up a clinical group which lies on the borderline of psychiatry and internal medicine. Psychosomatic medicine is concerned more with a medical *point of view* in looking at men longitudinally and completely, rather than in parts or cross section, or as specific clinical entities. The object is to understand the interrelation of the psychological and physiological aspects of normal and abnormal bodily functions. Psychosomatic investigation has importance in evaluating the so-called "functional" and "organic" elements in illness, incipient illness and illness with a neurotic coloring.

The military service is concerned with this field in reference to how signs and symptoms might interfere with the efficient function of a man as a soldier. Even though an individual may not be specifically diseased in mind, body or organ, his *disorders* or *dysfunctions* may be of such a character as to render him useless in Army service. Psychosomatic medicine points out that not only mental illness but manifestations of physical illness may be dependent upon emotional factors, that acute or chronic *emotional tensions* may be disturbing the body's physiology. These tensions originate in *personality maladjustments* which prevent harmonious adjustment to excessive environmental strains. Research workers have shown how physiology may be interfered with by fear as well as by infection.

The main physiological changes closely related to emotions are changes in *secretion*, *muscle tension* and *circulation*. Such changes even though emotionally caused can so disturb organic function that it might eventually lead to an actual organic disease. These emotional conflicts arise from the general life of the men coming from worry, anxiety, fear or nervousness. The main concern is *how* the individual *regards* the presence of these difficulties and how he *handles* them in attitude and behavior. Men showing any signs of various forms of *tension* should be given special study by history and other observations. Under the increased stress and strain of military life such

\* Published in part by the author in *Psychiatry: Journal of the Biology and Pathology of Interpersonal Relations*, Vol. IV, No. 2, May, 1941, as part of a section on Selective Service Psychiatry.

potential difficulties may become exaggerated and lead to disabilities.

With these viewpoints in mind, extra effort should be expended to spot any individuals who are likely to possess such reactions. This is not so much treatment of an actual condition as it is a means of prevention of serious breakdown which is common in this type of man. An outline elaborating on what should be kept in mind is presented herewith. It is practical not only in connection with this subject, but in relation to *any* psychiatric observation.

**Observation of the Individual.**—The general total objective observation of the person is an important approach. Combined with physical findings and history one may get the proper impression as to the general adjustment.

The *attitude* of the person is important. Frankness or reticence may show the degree of maturity or anxiety.

*Appearance* and *attire* and *personal habits* on one hand may show effeminacy, overpreciseness and indications of mental and emotional rigidity. On the other hand, being careless or slovenly might indicate a poor mental capacity even if the subject is intellectually normal.

*Posture*, *expression* and *speech* particularly reflect thought and emotion. Voice tremors, stammering, stuttering, and vasomotor changes such as increased sweating, inconsistent tachycardia or complaints of dizziness and faintness give leads for further examination. General oversensitiveness or "nervousness" or undue muscular tension may indicate increased emotional tension.

**History and Questioning.**—The main difference between an ordinary history and a "psychosomatic history" is that the history is given different evaluation. Much depends on a physician's skill in reading in the proper significance. What is needed is a general impression about total reactions of the patient to himself, his body, personality, family, work and towards sex and the military environment. It is important to know how much insight he has into these reactions. Of particular importance is the attitude of the man toward illness, invalidism and physiological sensations or changes. A significant history would be one of a long series of illnesses in which there is a disturb-

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fullness, dermatographia, skin excoriations, bitten fingernails, overspastic anal sphincter, overreaction to abdominal palpation, and even the presence of acne and scars.

### CLINICAL DISEASE ENTITIES RELATED TO PSYCHOSOMATIC MEDICINE

The clinical medical conditions that are found closely related to psychosomatic concepts of illness should include hyperthyroidism, essential hypertension, D.A.H. (disordered action of the heart, effort syndrome, neurocirculatory asthenia), coronary spasm, peptic ulcer, spastic or chronic constipation, mucous colitis, asthma, allergic reactions, eczema, pruritus, rheumatoid arthritis, diabetes, and many others. In many of these clinical pictures the emotional factors are part and parcel of the etiology and, unless coped with, remissions may be only temporary, relapses frequent, or a state of chronicity the final outcome. Listing characteristic symptoms for any of these conditions involves many repetitions of symptoms and groups of symptoms. When disturbance occurs in the organism certain organs or systems react with symptoms or signs. This is true when the origin of the disturbance is emotional just as much as when it may be of a mechanical or infectious origin. The disturbed function of the organ or body system is simply a dynamic loudspeaker of the personality announcing that trouble is contained within the organism. What portion of the body happens automatically to be chosen to speak matters not at all, and why one person reacts in one way or with one manifestation of disturbance rather than another is unknown.

From the list of clinical conditions cited before certain ones are especially common and what is characteristic of one is often found in all.

**Hyperthyroidism.**—The number of cases of this condition reported in soldiers of the World War was out of proportion to its incidence in civilian life. Case reports concerning exophthalmic goiter agree commonly as to the high percentage of emotional strain or psychic trauma as exciting causes. Continued anxiety or annoyance and torturing worries are more important in the etiology than acute fear. Thyroid disturbance occurs in individuals of a personality type who react to excitement and

ance of muscular tension, secretion or circulation such as seen in colitis, gallbladder disease and frequent gastro-intestinal disorders. The load of fear, anxiety and mental conflict in relation to the total personality must be known. Specific things that should be studied are as follows: a history concerning poor sleeping, bad dreams, easily occurring anxiety, the occurrence of headaches, dizziness, with or without evident physical reason, episodic eye sensitiveness, asthma, urticaria, "chest depressions," dyspnea, pain over the heart, flutterings and poundings of the heart, indigestion, irregular gastro-intestinal function, impotence and episodic alcoholism. The best approach naturally is examination by means of a simple personal conversation.

It is important to use great care in history and examination because in many cases nervous or emotional conflict is extraordinarily well concealed and many a man having an actual somatic disorder may appear to be a "completely normal happy person." Through the history may be ascertained the total picture of body, personality, and effect of environment. Their interrelations make or break a man's adjustment to stress and strain.

**Methods of Study Other Than History.**—If conditions permit, certain help can be secured from cardiovascular studies, psychogalvanic studies, metabolic changes, sweating and reflex studies, electroencephalography, and the use of cardiometer and x-ray fluoroscopy.

**Special Physical Examination Findings.**—Single findings may have no particular significance but in conjunction with others the sum total may give a definite impression about the man's stability. Disturbance of the cardiac rate or rhythm should be consistent with activities. Transient hypertension may be a remarkable index of focal instability. Excessive sweating, tremors of any sort, blushing and clammy hands and feet are often seen whether the objective complaint be cardiovascular, gastro-intestinal, or relating to any other system. Large pupils, hyperreflexia and a marked gag reflex sensitiveness are equally significant. All of these are common indications of lack of emotional control or showing hypersensitive autonomic nervous responses. Other minor physical difficulties that might give a lead are slight exophthalmos, a slight thyroid

most often to be seen in the somatic response as a form of nervous tension. Mental states conducive of this response appear to be those of anxiety, resentment and guilt; a rigid type of thinking mind was found in 50 per cent of the cases. Associated depressive, neurasthenic and hypochondriacal features are often present, but no one psychiatric diagnosis comprises the mucous colitis or other gastro-intestinal groups.

With few exceptions any type of gastro-intestinal disorder would tend to fall within these patterns. It calls for no great stretch of the imagination to arrive at the conclusion that, insofar as possible, care must be taken in treating any man in the service who could be classified medically in these descriptions, if he be left in service.

**Cardiovascular Conditions.**—These include many symptomatic syndromes, called *neurocirculatory asthenia* (effort syndrome, D.A.H.), *coronary spasm* and *essential hypertension*. There is little agreement in the medical profession as to their significance and relationships. Their symptoms are manifold, usually directly related to pain sensation, changes in the cardiac rate, various types of heart consciousness, side symptoms of the respiratory or chest type, general symptoms of weakness or fatigue, and disturbances of cerebral sensation.

**NEUROCIRCULATORY ASTHENIA.**—At a recent Medical Defense meeting held under the auspices of the Philadelphia County Medical Society, Dr. Thomas McMillan discussed neurocirculatory asthenia and similar conditions related to the cardiovascular disorders.

His experience was both in military and civil life. He emphasized the point that disturbance seen in civil life, although troublesome, is nothing like the degree of disturbance seen in the service. His discussion may be summarized as follows:

"The main symptoms of neurocirculatory asthenia are breathlessness on exertion, various degrees of palpitation and tachycardia, precordial pain, sweating and cold clammy extremities, dizziness and fainting, fatigue and exhaustion. Cases may be divided into the incapacitating type and those of lesser grade.

"In the *severe types* breathlessness is exceedingly common but is not present at rest or during sleep, and usually is not



psychogenic trauma with development of excessive and prolonged tension. Common personality traits are those of a strong sense of responsibility in regard to life obligations and strong feelings of dependency on parents or others for guidance and protection. The hyperthyroid state appears in many of these persons when a serious environmental happening such as death, serious illness, or marriage threatens their intense relationship to other individuals. The early symptoms of anxiety may precede localization of disturbed function in the thyroid and most often would be in the form of cardiac and vasomotor functional disturbance.

**Gastro-Intestinal Disorders.**—These include *peptic ulcer*, *chronic* or *spastic constipation*, *mucous colitis*, and many other mixed gastro-intestinal syndromes. The early symptoms are naturally many in number. First, they may be varied, involving several different functions of the entire intestinal tract before apparently becoming more localized. Second, tension phenomena, such as intermittent spasm of the cystic duct, causing gall-bladder discomfort, or spasm of the common duct, causing slight jaundiced episodes, are frequently encountered in tributary smooth muscle channels. Third, the generalized symptoms of anxiety are expressed in the cardiovascular, gastro-intestinal, respiratory and vasomotor systems, even though localization may take place in the gastro-intestinal tract later. The characteristics of the mucous colitis group might be used as typical of the kind of people, of personalities, who would tend to develop gastro-intestinal disorder. A recent study from the Medical Clinic of the Massachusetts General Hospital and the Department of Medicine of Harvard Medical School may be summarized as follows:

1. Symptoms are seen in people who have labile autonomic nervous systems with concurrent cardiovascular instability.
2. Cardiovascular symptoms, such as palpitation, sweating and faintness, are often encountered. The stigmata of instability of the autonomic nervous system—flushing, sweating, cold moist hands, instability of the pulse rate, dilation of the pupils, and abnormally red skin response to scratching—are frequently encountered.
3. The psychogenic factors as precipitating agents seem

although at times the physician must use his judgment in accepting those showing milder disturbance."

**Application of Psychosomatic Findings.**—When clinical symptoms are bothering the patient, no line can be drawn between the psychosomatic potential condition and a fully developed, so-called anxiety or cardiac neurosis.

An unusual type of physiological function and *potentials for disorder* are plainly evident when these reactions are encountered in the history or examination of men.

From a practical standpoint, it must be stated that, just because a man may show a few, or many, signs of vasomotor instability, emotional tension, and transitory or chronic organic dysfunction, it would not necessarily follow that he would be unable to adjust to camp or Army life. These findings only show that such a man should be carefully studied. Information as to how he handles these symptoms or reactions—what his attitudes may be toward them—is more important at times than are the findings themselves. A decision regarding his use in the Army or his elimination depends on a man's capacity to adjust in the presence or absence of signs and symptoms of this character, judging him more from his past history, his adjustment in his everyday and military life, and his general capacity to maintain what seems to have been characteristic of him in the past.

#### Group V. Prepsychotic and Postpsychotic Personalities in Schizophrenia (*Dementia Praecox*)

This group makes up the most frequently seen type of mental disease in civilian life, and is commonly found among the problems of military life. It is debatable as to the effect of stress and strain in producing these conditions. Usually one expects a gradual, insidious development beginning in late childhood, during which introverted, seclusive and "queer" personality changes mark the progress towards mental disorder. Certain cases may develop in the service; others may have existed before induction, perhaps have been under treatment, with recovery, or gone into a remission, with recurrence. The prodromes discussed before are important in spotting these personalities.

accompanied by cyanosis. Fatigue is very marked and is a real sensation to the patient. It is often accompanied by tremor and is produced by the slightest exertion, either mental or physical. Precordial pain is present in at least a half or more of the patients, and is usually never substernal but usually over the apex beat. Although it can be quite severe, it is often more of an aching sensation. Palpitation is a symptom and tachycardia after exercise might go to as high as 160 heart beats per minute. Tachycardia is not present in sleep and at rest the pulse is slow; in a sitting position, however, the heart rate becomes accelerated. Fainting and giddiness of various degrees is not infrequent. Cold, clammy, bluish, sweating extremities and a tendency to excessive perspiration elsewhere in the body is almost always present. Dermatographism is common. All those symptoms are found often in patients convalescing from infectious diseases and other illnesses, but in neurocirculatory asthenia they occur in those who seem to be very healthy individuals.

"The mental status is important and often significant. The patients are frankly glad to be in a hospital and out of the 'line.' They are often preoccupied, show some anxiousness, but it seems more in proportion to their complaints than that found in a 'pure anxiety neurosis.' The patients are not too worried nor are many specific abnormalities found which could be considered psychiatric. The wards where they are billeted are depressing, quiet, and differ markedly from those wards where men with other disabilities are cared for. There is great lassitude and fatigue both mentally and physically, with marked disinclination for physical exertion and mental concentration.

"The *lesser grades* are simply less severe, and may readily go into the incapacitating type.

"The problem is to look for potential cases—persons who are constitutionally unsuited physically to the rigors of war-time service and who may be potentially neurotic. Those who react with a poor exercise tolerance, unstable blood pressure, unstable pulse rate, tremors, sweating and other evidence of psychosomatic instability are the ones to be examined most carefully. The worst among these, of course, should be rejected,

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centage of cases. Every effort must be made to socialize these patients, stir their interest in reality, and maintain their adjustments. Symptomatic treatment is employed in every possible manner to keep their physical and mental condition as good and as objective as possible. With the paranoid states, the establishment of good rapport is important, allowing the patient to "talk out" his ideas without combating them by argument and disagreement, and under conditions where patience, forbearance and special consideration are practicable. It is obvious why treatment except at a hospital center is impractical.

Special measures of medical treatment, with the help of insulin shock and electro-shock, hold promise of cure in certain cases.

Temporary paranoid reactions, as a part of personality disturbances often seen in handicapped individuals who are deaf, who have been blinded or who are suffering from toxic conditions or cardiac decompensation, must not be confused with these conditions.

#### Group VI. Alcoholism

During active service alcoholism does not usually become an acute treatment problem as the situation is somewhat controlled by environmental factors. Chronic alcoholics who have slipped through induction naturally will become disciplinary problems. It is also likely that if they continue in the service their maladjustment will tend toward an acute breakdown in some other form, such as a psychoneurosis, or even a psychotic episode. Pathological drinking might be one of the first indications of personality change or beginning organic mental disease or deterioration.

TREATMENT would be directed toward the fundamental personality disturbance as much as toward the alcoholism. Transfer in duty might solve the problem temporarily.

#### Group VII. Syphilis of the Central Nervous System

#### Group VIII. Other Organic Disease of Brain, Spinal Cord and Peripheral Nerves

These two groups are related particularly in the matter of neurological diagnoses and treatment.

When the condition is established, characteristic symptoms are seclusiveness, irritability, untidiness, suspiciousness, fantastic delusions concerning the subject's own identity and his relations with his associates, and still other delusions showing a peculiarity in thinking with sexual content, involving ideas of influence and control. Hallucinations of hearing are common; visual hallucinations and strange body sensations (often genito-urinary) are possible. Early cases may seem to be a severe psychoneurosis, but they usually move on rapidly to such extremes in thought and conduct that a malignant psychotic state is obvious. Behavior changes include unmotivated outbursts of rage, refusal to eat or remain clothed, filthiness in personal habits, and almost total response in behavior to the influence of what "the voices" tell them to do. Catatonic reactions, with posturing, physical immobility and varying degrees of stupor, are not uncommon. The characteristic withdrawal socially, the disorder of thinking and the generally queer, fantastic attitudes, mental and physical, accompanied by a dullness or apathy of emotion, are dissimilar to other psychotic syndromes.

The *paranoid states* of this classification, while presenting about the same picture, show less dilapidation of general thinking and behavior and, in addition, are characterized by an extremely well developed and organized system of suspicious paranoid ideas and delusions. The sufferers complain or are constantly irritable and resentful in word and action because they are being made the "butt" of jokes, looks and actions; that all people and things are deliberately organized against them; that all happenings about them have hidden meaning and purpose. They are defensive, hostile and often aggressive in such an illness and may be dangerous. The British report these states as the greatest source of disciplinary trouble, unrest and damage to morale in troops, particularly during inactive periods.\*

**TREATMENT.**—Inasmuch as these are psychoses, early detection and evacuation are important. Treatment, when available, is a hospital procedure, since these conditions tend to be prolonged, chronic or unaffected by treatment in a large per-

\* Miller, Emanuel: *The Neuroses in War*. New York, The Macmillan Co., 1940.

to elation, delusions of grandeur and other signs of a psychotic character. Similar reactions, though less common, may occur in multiple sclerosis and brain tumor.

In *diseases of the spinal cord* mental changes are not the rule, but in some of the degenerative processes and particularly in acute infectious conditions there may be disorientation, confusion, paranoid ideas and other evidences indicating toxicity.

**TREATMENT.**—Treatment of most of these conditions is practicable only in hospital stations. It differs in no way from that of civilian practice. Evacuation is indicated in nearly all cases, mainly because they usually should have prolonged study before accurate treatment can be organized. The importance of complete serologic examination, including spinal fluid, cannot be too greatly stressed. All cases of *epilepsy* need prolonged study before adequate treatment can be planned, and the epileptic or epileptic equivalent cannot be considered a good risk for front line duty.

The treatment of *injuries* is primarily a surgical matter. It is not reassuring to either surgery or neuropsychiatry to learn that careful treatment of brain wounds in dressing stations and field hospitals was impossible in the German campaign in Poland owing to the mobility of the campaign.\*

**Delirium.**—Delirium may be seen in conjunction with many of these conditions. Nursing care is important for this complication, with careful symptomatic treatment to control infection, maintain the food intake and promote elimination. Hydrotherapy and guarded sedation may be indicated. Special attention should be paid to the surroundings of the patient and to psychotherapy by means of reassurance and quiet explanation. Protection of such a patient both for himself and others is important to prevent accident, suicide or homicide. Paraldehyde and sodium amytal are the sedatives of choice. The administration of saline solution with glucose and insulin may be very helpful, as it combats dehydration, cerebral edema and acidosis through stimulating and aiding normal physiological function. One method† is to give 100 cc. of 50 per cent glucose, 50 units of insulin, and 120 mg. of thiamin chloride intravenously at one time with a 20-gauge needle. This is fol-

\* Tonnies, W.: *Deutsch. med. Wchnschr.*, 66: 57-58 (Jan. 19) 1940.

† Rivers, Theodore D.: Personal communication.



General observation by the experienced medical officer plus careful neurological examination will be the basis of accurate differential diagnosis of functional and organic conditions. Changes in personality characteristics or emotional or behavior disturbances may be evidence of incipient psychosis and psychoneurosis; they also may point to grave neurological disease. Psychotic symptoms may develop from a general psychiatric disorder or they may have a focal origin such as brain concussion or injury. These possibilities indicate the importance of careful differential diagnosis.

Clinical conditions included within these groups are as follows:

*Syphilis of the Central Nervous System*

General Paresis

Tabes Dorsalis

Cerebrovascular Syphilis

*Diseases of the Brain, etc.*

Epilepsies and Equivalents

Multiple Sclerosis

Brain Tumor

Encephalomyelitis

Primary Chronic Degenerative Disease

*Diseases of the Spinal Cord*

Meningitis

Subacute Combined Degeneration

Progressive Muscular Atrophies and Dystrophies

Cord Tumor

Syringomyelia

*Diseases of the Peripheral Nerves*

Neuritis or Multiple Neuritis

Cranial Nerve Disease

*Trauma of the Central Nervous System*

Except for conditions following trauma, and epileptic disorders, most *diseases of the brain* have prodromes in which there is gradual onset of symptoms indicating deterioration in judgment, emotional stability and recent memory. As the condition progresses there may be a change in behavior shown by emotional outbursts, a lack of attention or of former efficiency in line of duty, and neurological signs such as tremors of face and hands, speech defects, sensory changes and various abnormalities in reflexes.

In *general paresis* such signs are common and in addition, there may be marked changes in mood varying from depression

quencies in recoverability. Concussion, exhaustion and tension states showed the best responses; conversion hysteria, "gas neuroses" and neurasthenia were next; the anxiety and obsessional states, and effort syndrome reactions did not respond as well. A number of anxiety and effort syndromes tended to be permanent.

#### TREATMENT AND MANAGEMENT OF NEUROPSYCHIATRIC EMERGENCIES

It appears that 1941 combat technic differs widely from that carried out even in "recent" wars. At present the so-called "front line" seems to be a road with a column of troops which may change position ten or fifty miles a day. Perhaps evacuation hospitals or at least base hospitals may possess some stability in placement. Under these new conditions it is obvious that a discussion in detail of sensible, practical measures of treatment, adapted to situations which change momentarily, is not feasible. The best approach apparently is to present certain principles in regard to the treatment and management of emergency situations in general. The application of such principles beyond that must be left to the experience, training and especially to the ingenuity of the effective medical officer. Techniques of treatment will be subject to modification forced by the limitations of time, place and personnel.

**Preliminary Study.**—All treatment must be based on a knowledge of psychopathology, of knowing what the patient is and has, as an individual personality. A careful history covering obvious complaints, present illness, past medical history, family, and personality development must be worked out in the usual manner. Elaborate histories naturally are not possible, but for effective and early treatment some knowledge must be obtained of the underlying nature of the condition. At first the medical officer must rely on careful observation, and he must also secure information from the patient's associates, particularly from the "top" sergeant, as well as from commissioned officers. Physical and neurological examinations furnish the necessary information, particularly in those confusing cases in which disabilities may be functional (conversion hysteria) or organic in origin.

lowed by large amounts of orange juice fortified by glucose by mouth. This procedure may be repeated in three hours. Little or no sedation is needed. Further small doses of insulin (20 units t.i.d. 25 minutes a.c.), balanced by carbohydrate ingestion, may be given for a day or two longer. High caloric, high vitamin diet should be routine. A second method gives a larger amount of saline solution with less glucose, and adds insulin subcutaneously, 1 unit for every 2 gm. of glucose administered. Additional routine treatment includes orange juice, glucose and insulin, vitamins A and B<sub>1</sub>, and nicotinic acid.

These two methods were worked out mainly in the treatment of alcoholic delirium tremens, but should be of use with variations in any type of delirium, depending on its origin and the condition of the patient.

### PROGNOSIS

The more "normal" the heredity, constitution and general personality of the soldier, the less likely that psychiatric disability will occur, and the more likely are recovery possibilities if it does occur. Older men are apt to do poorly as compared to younger men; officers do not respond as well to treatment and do not return to duty as often as the common soldier. Conversion hysteria is more common in the ranks than in the more "intellectual" personnel in whom the other forms of psychoneurosis (neurasthenia, anxiety states, obsessive compulsive reactions) are more frequent. Major psychoses appear in those who are probably already predisposed; at any rate a return to duty is risky and unlikely. In the front line, psychoneuroses tend to be more severe, and are often accompanied by some clouding of consciousness at the onset; however, this is not a bad sign as such cases (if organic involvement is not present) usually respond well under treatment.

These general facts apply both to front line situations and encampments. The *earlier* treatment is applied the better the results, but often treatment facilities are limited at the early stages. Later treatment may be handicapped in the time element but treatment possibilities are technically better in encampments or hospitals.

Psychoneuroses in World War I followed certain fre-

background as well as his present life, must be interpreted again and again in order that he understand the treatment he is receiving. He must be given more advice than patients in civilian life. The purpose is to help him regain the adjustment he had, not to change him. As treatment by the re-educative process goes on, his daily life should be organized systematically in work, play, exercise and rest. He must be obligated to carry out such an organized life, regardless of his temporary reaction to it. Occupational therapy as a part of this type of life is important. Psychotherapy is the center and the strength of a treatment plan of this character.

**Treatment by Medical Officers Untrained in Psychiatry.**—During the past year, various issues of the *Lancet* have carried articles on the "acute war neurosis" and allied clinical subjects. As a result there have been many "Letters to the Editor," in which views pertaining to psychiatric disabilities and treatment have been argued by several well known English medical men. A review of these articles and letters shows a striking contrast between the views of medical men who have been psychiatrically experienced or educated, and those of physicians who tend to revive viewpoints held during the last war. As might be expected, there has been a stupid revival among some medical officers of attitudes of contempt and technics of brutality in the treatment of war neuroses. One physician admitted, however, that he no longer was successful in "scaring" the patients into recovery, because "they are much more afraid of a bomb than they are of me, and a bomb certainly is some reality." Others are reporting surprising success in men with severe neuroses resulting from the strain of front line duty, by employment of such simple means of treatment as rest, food, reassurance and suggestion. This success is often reported by medical men not experienced as psychiatrists, who use psychotherapy as a therapeutic measure, as any medical officer should.

Treatment of this kind is important, effective, and productive of results. Ideally it should be carried out by a medical officer who is a psychiatrist. Inasmuch as this may not be possible in many military units, the treatment must be applied by the medical officer responsible, who may not happen to be

Treatment measures, particularly for the psychoneuroses, psychosomatic disorders and borderline conditions, must be based on the carefully taken history and the physical examination. Treatment must be definitely and carefully planned, on a long-time basis, and it should preferably be in the hands of the same medical officer for its duration. As a rule, only under such circumstances can it be carried out systematically. With only a few exceptions, it must be conducted under much the same degree of discipline previously experienced by the soldier.

**Psychotherapy.**—Psychotherapy is employed in conjunction with proper general medical treatment. The sooner psychotherapy is instituted the better. With the psychoneurotics, treatment in centers or hospitals near the front, in cases of recent development, is likely to be more effective than later treatment following evacuation. Suggestion and persuasion are usually sufficient, if judiciously applied shortly after instituting a short period of rest, good food, followed by quiet but gradually increased activity and recreation. Longer treatment or the handling of involved situations can call on more explanatory therapy or deeper discussion of the individual's problem. Such an approach may be elaborated in a base hospital setting, but it is possible even under difficult front line situations to put into effect psychotherapeutic treatment. Hypnosis, sedation and other special aids may be useful as temporary means of establishing rapport.

Continued psychotherapy, particularly when there is ample opportunity to carry it on under reasonably favorable conditions, should follow a certain procedure. The patient should be interviewed alone if possible, and explanations of his symptoms and interpretation of the problem as a whole should be frequent. All this should progress in an atmosphere of kindness, friendliness and personal interest, but without relaxing fundamental discipline. Positive suggestion should be actively used to influence the attitude toward health, danger, discomfort of military life, noise and discipline. It is important to expose the *meaning* of symptoms to the patient for his understanding and insight, which, although gradually acquired, must be not only intellectual but emotional. The reasons for his illness, its accidental associations and happenings, both in terms of his

Physiotherapy

*Hydrotherapy*

Continuous bath:

Patient lies full length in bathtub; constant change of water, temperature limits 95° to 98° F.; for restlessness, tension, anxiety, insomnia and general toxic effects.

Spray showers:

Needle spray; hose stream, etc. Tonic and stimulative value.

*Massage*

General massage for tonic effect; good in exhaustion and fatigue states in conjunction with mild exercise.

psychiatrically trained. To conclude this section on treatment it must be stated unequivocally that *any intelligent medical officer who uses general medical common sense combined with a reasonable degree of acceptance of known established psychiatric principles and orientation, can successfully apply these principles of treatment in a majority of cases.* This will not only mean the rehabilitation of patients but it will be of immense practical value in saving both money and manpower for the military service.

### SPECIAL THERAPEUTIC TECHNIQS

#### Emergency Routine

##### 1. Admission

Bed rest—warm drink (or suitable fluid intake); sleep (hypnotic if necessary).

Full diet—fortify with hypodermic vitamin B<sub>1</sub> (unless medical indications prohibit).

##### 2. General Treatment

Specific medical symptomatic therapy as indicated.

As above—carried out in surroundings which are quiet or in relative isolation, or where patients equally or less ill are cared for.

Continuous narcosis for one or two days for the more severely ill.

Early use of suggestion, persuasion and stimulative measures (hydrotherapy).

Use of sedatives to control tension, anxiety and insomnia.

##### 3. Continued Treatment

Gradual increase of mental and physical activity by means of occupational therapy, graduated exercise, short periods of work, social activity and recreation.

Psychotherapy through discussion, explanation and re-education.

Organized schedule to be carried out under supervision of one medical officer.

#### Symptomatic Measures

*Sodium chloride* (common salt)—2 gm. every four hours; for excessive perspiration, derilium, shock, with full diet and fluids

*Insulin and glucose*—100 cc. of 50 per cent of glucose and 50 units of insulin intravenously for shock and delirium.

*Thiamin chloride*—120 mg. intravenously for vitamin B<sub>1</sub> deficiency (or with above in shock or delirium).

*Tincture of belladonna*—5 to 10 drops t.i.d., p.c., for relief of tension, local or general. (Watch for overdosage in dehydration, etc.).

*Benzedrine sulfate*—5 to 10 mg. in the morning and/or at noon for depression, hypotension.

*Phenobarbital* (luminal)— $\frac{1}{8}$  to  $\frac{1}{4}$  grain t.i.d., p.c., for tension, mild sedation, or hypertension. Larger doses are safe.

*Sodium amytal*—0.2 to 0.5 gm. at night as sedative; 0.3 to 0.6 gm. (intravenously) for mild hypnoidal state

*Paraldehyde*—6 to 12 cc. at night as sedative; 10 to 15 cc. (20 cc by rectum) to combat delirium or for mild hypnoidal state.

## IMPROVISED DRESSINGS AND TRANSPORTATION OF THE WOUNDED

RALPH GOLDSMITH, M.D., F.A.C.S.

FORMERLY CAPTAIN, MEDICAL CORPS, UNITED STATES ARMY; SURGICAL CONSULTANT, SELECTIVE SERVICE BOARD

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### IMPROVISED DRESSINGS

IN civil practice the present trend is toward standardization of equipment for the treatment of injuries. A perusal of the standard works dealing with traumatic surgery reveals more similarity than divergence among them. Effective simplicity is stressed and gadgets are deprecated. This situation obtains to a far greater extent in military surgery and is especially characteristic of emergency or first aid equipment. The Medical Department of the Army of the United States designates and provides a standard first aid package (Fig. 202) and makes no provision for improvised dressings, depending, no doubt with good reason, upon the ingenuity of the individual medical officer and soldier to utilize any available material to replace or supplement inadequate regulation supplies. The purpose of this contribution is to suggest some makeshift auxiliary measures in the emergency treatment and transportation of the injured. No originality is claimed for the material presented.

**Type of Dressing.**—The emergency treatment of wounds entirely without formal equipment should be governed by the principle, *the less the better*. Under war conditions the vast majority of wounds are those caused by projectiles. Naturally they vary tremendously in type and severity, running the gamut from the perforating wound caused by high-velocity rifle or machine-gun bullets traversing only muscular organs and doing little damage, to the most bizarre and mutilating injuries. The former require little in the way of dressing; the latter are





bandage used for the ankle without including the toes is shown in Fig. 204.

*Bandage for Heel.*—An oblong piece of material slit at each end and tied, as shown in Fig. 205.



Fig. 203.



Fig. 204.

Fig. 203.—Bandage for foot and ankle. (Olson, "Improved Equipment.")

Fig. 204.—Bandage for foot and ankle, but without wrapping the toes. (Olson, "Improved Equipment.")

*Bandage for Knee.*—The same type of bandage is used as for the hand and foot (Fig. 206).

*Bandage for Hand.*—A square piece of material is folded at the center, wrapped, and tied about the wrist (Fig. 207).



Fig. 205.



Fig. 206.

Fig. 205.—Bandage for heel. (Olson, "Improved Equipment.")

Fig. 206.—Bandage for knee and foot. (From Harmer, "Principles and Practice of Nursing." By permission of The Macmillan Company, publishers.)

*Four- and Six-tailed Bandages for Head.*—An oblong piece of material tied at both ends with four or six tails will hold a head dressing in position (Fig. 208).

quite beyond the scope of improvisation. It must be understood that no dressing at all is usually better than an unclean one; that well intentioned efforts to "do something" for an injured person may be disastrous; that bleeding, if it be slight or moderate, is salutary rather than dangerous and that a little blood makes a big stain. If it is felt that a wound must be covered, either as a measure of hemostasis or to prevent further contamination by dirt, flies, or other agents, the dressing

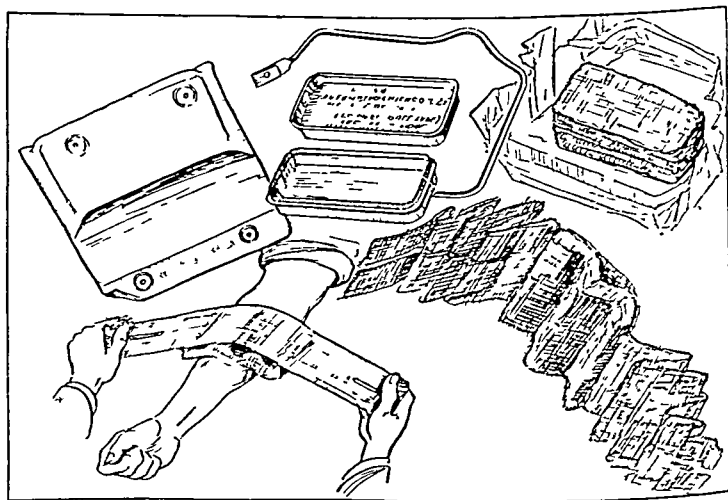


Fig 202—Standard first aid package of the United States Army (From Military Medical Manual, 4th Ed, published by The Military Service Publishing Co.)

should be of the cleanest material available. The wound itself should not be touched by hands until this can be done under proper conditions.

Some small ingenuity may be exercised in providing extemporaneous means of keeping dressings in place. A piece of material such as a large handkerchief or part of a shirt may be used.

**Special Bandages.**—*Bandage for Foot and Ankle.*—Fold the material diagonally at the center; wrap around the foot and tie at the ankle as shown in Fig. 203. The same type of

apparatus is available. As for what may be used for splinting, one must use what he can get. A flat piece of wood to which the injured part is secured is probably the thing most frequently utilized. If this cannot be found, a tree branch, a piece of heavy wire folded upon itself like a hairpin, a strip of metal, a fence post, a roll of paper, or indeed anything with sufficient rigidity to immobilize the injured part may be used. Once applied, the improvised splint should not be disturbed until it can be replaced by a more satisfactory appliance.

It is often desirable, especially in fractures of the lower extremity, to provide *extension* of the injured limb. This can be

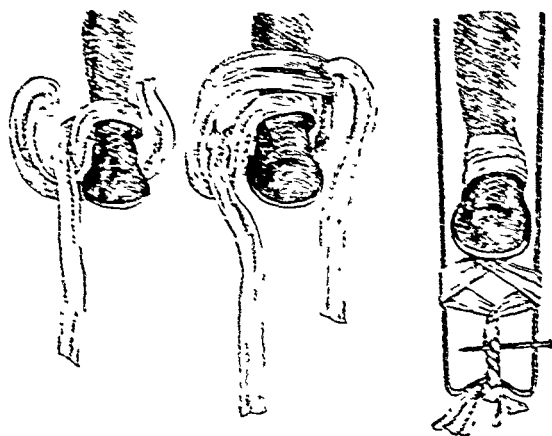


Fig. 209.—Traction hitches for field transportation. (Blake.)

accomplished by the use of a cinch, such as the Collins cinch (Fig. 209), made of a necktie and tied about a nail driven solidly into the splint below the foot.

*Fractures of the arm* usually require a sling. This can be made of any available material, such as a piece of a shirt, a necktie, or suspenders, or the arm may be supported by slipping the hand and forearm into the space between the buttons of the coat or shirt. *Fractures of the humerus* may be supported by tying the injured arm snugly against the body. Likewise, a *fractured leg* may be tied to the sound one, which acts as a splint, if nothing else can be found.

*Chest or Abdominal Bandage.*—A shirt may be used. The sleeves may be cut off and tied about the body for greater security.

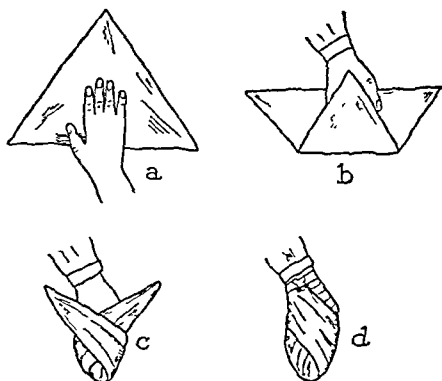


Fig. 207.—Bandage for hand. (Olson, "Improvised Equipment.")

*Bandages for Arms, Legs, and 'Fingers.*—These are best made by tearing material into strips and using the latter in the manner of an ordinary bandage.



Fig. 208.—Four- and six-tailed bandage for head. (From Harmer, "Principles and Practice of Nursing." By permission of The Macmillan Company, publishers.)

*Fractures, Dislocations and Sprains.*—Improvised dressings for fractures, dislocations and sprains should be confined to *splinting* in as effective a manner as possible. The oft-repeated dictum, "Splint 'Em Where They Lie," is nowhere more applicable than in situations in which no conventional

cut or tear away burned clothing from the patient until he has been removed to a place where he can be properly treated. Don't smear the burn (unless it be a relatively small and superficial one, in which case it makes no difference) with butter, grease, ointments, and above all, with carron oil. The

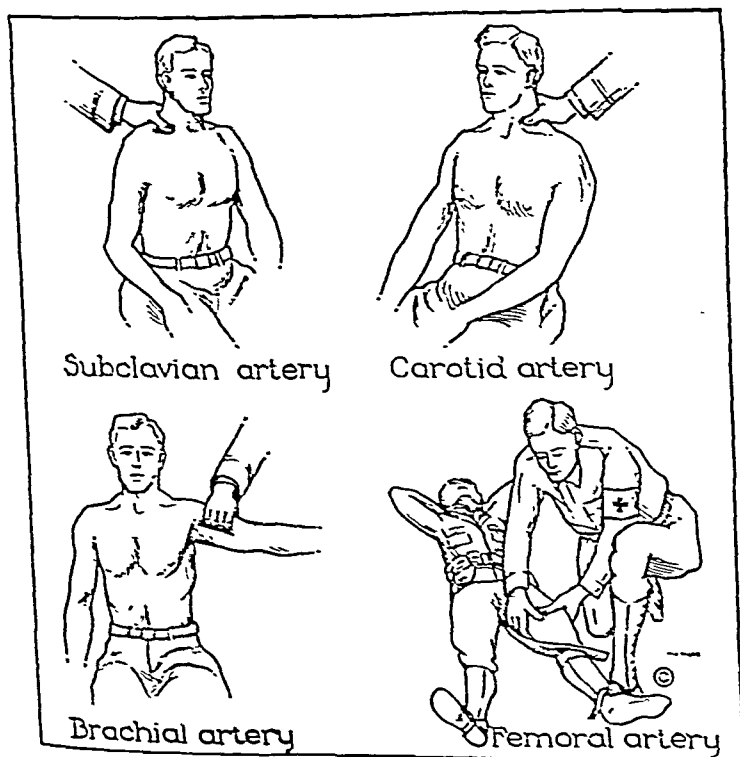


Fig. 210.—Control of hemorrhage by pressure over main arterial trunks. (From Military Medical Manual, 4th Ed., published by The Military Service Publishing Co.)

modern, approved treatment of burns with tannic acid, silver nitrate solution or the triple dyes necessitates the complete removal of all grease from the burned skin, a procedure so painful as to require an anesthetic in many cases. If one feels irresistibly impelled to smear something on a burn, let it be

*Fractures of the skull* per se obviously require no improvised dressings. It is well, however, to bear in mind that an individual with a skull fracture should be placed flat on his back with the head lower than the body. This position is used to combat shock and to prevent the descent of blood from the nose or mouth into the lungs. If the patient is unconscious it may be necessary to hold the tongue forward so that it cannot obstruct respiration.

**Hemorrhage.**—The emergency treatment of hemorrhage consists primarily in the application of physical measures to control bleeding. If bleeding is not too severe it may be controlled by *local pressure*. If the case is not suitable for such treatment—and most bleeding cases worthy of the name of hemorrhage are not—one has his choice of two methods. The first is *pressure over the main arterial trunk* leading to the bleeding point (Fig. 210). Obviously this method is not universally applicable. Further, it requires a knowledge of anatomy not possessed by every individual. For hemorrhage from the extremities, the *tourniquet* is probably more reliable and more readily used. Any object—belt, necktie, garter, suspender, folded handkerchief—which can be wrapped and tied about a limb will answer. A stick should be inserted beneath it and twisted just enough to stop the hemorrhage. If the bleeding is arterial, the tourniquet is placed proximal to the bleeding point; if venous, distally; when in doubt, it should be applied proximally. The tourniquet must be removed as soon as possible. Tentative loosening may be tried from time to time, when it may be found that less and less pressure is needed. The bleeding patient must be kept quiet and warm.

**Burns.**—The treatment of burns will naturally be conditioned by the burning agent and it is not now possible to speak of it in specific terms. Burns might occur from flame-throwers, incendiary bombs or ignited gasoline from the tanks of mechanized implements or airplanes. It is possible, however, to express certain dicta concerning improvised methods of treatment of burns in general. Again, these methods appear to be rather on the negative side. Since we are postulating the absence of any orthodox armamentarium, probably the most useful counsel that can be offered consists of “don’ts.” *Don’t*

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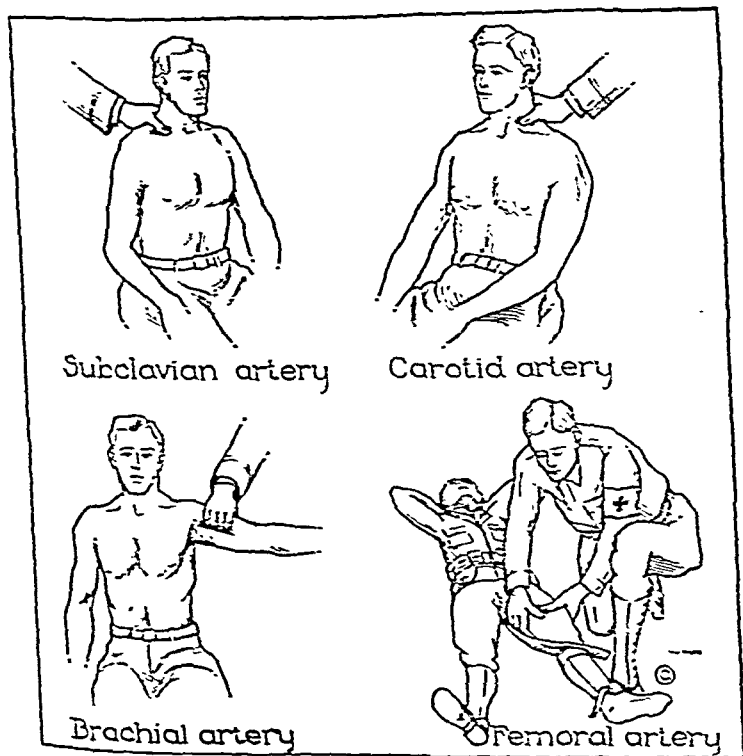


Fig. 510.—Control of hemorrhage by pressure over main arterial trunks. (From Military Medical Manual, 4th Ed., published by The Military Service Publishing Co.)

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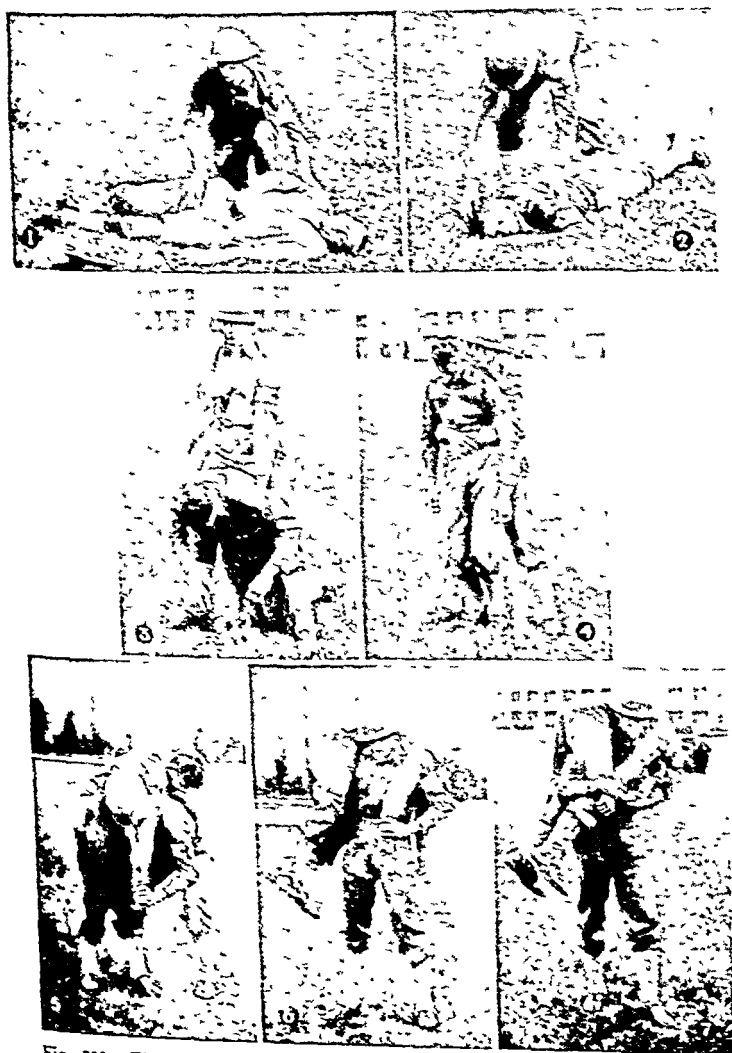


FIG. 211.—Fireman's carry. (From Military Medical Manual, 4th Ed., published by The Military Service Publishing Co.)

an aqueous solution of salt, baking soda or the like. This at least will do no harm and can be washed off fairly easily with water. Of paramount importance is *keeping the patient warm* and transporting him *with all possible speed and gentleness* to a place where he can get morphine and treatment for shock.

#### TRANSPORTATION OF THE WOUNDED

In the absence of motor- or horse-drawn ambulances or other vehicles, or in terrain unsuitable for the above, it is necessary to devise substitute means of transportation of the wounded. Of these, the most elementary is *carrying the patient* by one or more individuals. A number of methods are illustrated (Figs. 211 to 216).

*Stretchers* can be improvised, using a blanket, robe, overcoat, or slicker. When two poles can be found, they are to be placed on each long edge of the blanket and rolled toward the center until the desired width is obtained, and then tied securely in place. If no poles are available, the patient may be placed upon the blanket or coat and carried thus. However, this method requires four, or better six, bearers instead of the two needed to carry a stretcher with poles.

*To place a severely injured individual upon a blanket* with the least disturbance, lay the blanket beside the patient and tuck two thirds of it snugly against him. Grasping him at the hips and shoulders, roll him gently about one-eighth turn away from the blanket. Now push the tucked portion as far under him as possible, and roll him back over the tucked blanket and one-eighth turn in the opposite direction. Then pull the blanket through, thus placing the patient in the middle.

Naturally, if a door, shutter, or chair can be found it may be used for transporting wounded. An injured individual can be carried on a horse, or by a horse-travois (Fig. 217) or upon a board attached to the sidecar of a motorcycle (Fig. 218).

Undue haste should be avoided in transporting wounded. Few cases require breakneck speed, and much damage may be produced by rough handling. In both the emergency treatment and the transportation of the injured, *calmness, efficiency* without excited haste, and the *exercise of judgment and ingenuity* are of paramount importance.



FIG. 214—Two-man carry. (From Military Medical Manual, 4th Ed., published by The Military Service Publishing Co.)

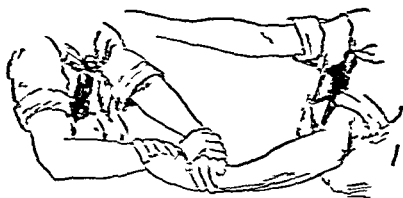


FIG. 215—Carrying patient by interlocking three hands and supporting back with the fourth hand. (Olsen, "Improved Equipment.")

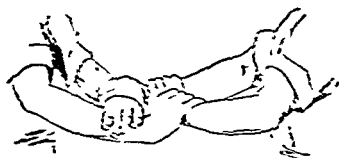


FIG. 216—Four-hand carry (Olsen, "Improved Equipment.")



Fig. 212.—Assisting patient to walk. (From Military Medical Manual, 4th Ed., published by The Military Service Publishing Co.)



Fig. 213.—One-man carry (From Military Medical Manual, 4th Ed., published by The Military Service Publishing Co.)

## X-RAY EXAMINATIONS OF THE CHEST FOR THE UNITED STATES ARMY\*

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### IMPORTANCE OF PULMONARY TUBERCULOSIS IN THE U. S. ARMY

**Economic Aspects.**—As of December, 1940, there were 2796 individuals retired from the Regular Army of the United States and receiving an average of \$66.25 per month because of "active pulmonary tuberculosis." There were 1195 others receiving an average monthly pension of \$27.77 partially due to "inactive pulmonary tuberculosis." Moreover, included among the beneficiaries of the Veterans Administration were 8329 cases of "active pulmonary tuberculosis," these being carried as casualties of World War I and receiving an average monthly pension of \$89.30. In addition, there were 44,763 individuals receiving an average monthly pension of \$46.01 of which part basis was "inactive pulmonary tuberculosis."<sup>10</sup> Spillman<sup>11</sup> has estimated that: "Tuberculosis during and after the World War has cost approximately \$960,000,000 to date in compensation, vocation training, insurance, and hospitalization," and that "within the next five years these costs will pass the billion dollar mark."

**Increase During World War I.**—Statistically, a sharp increase in the incidence of pulmonary tuberculosis during our last big mobilization was charted<sup>1</sup> (Fig. 219). No attempt will be made to explain this sudden increase. Let comments of those days suffice.<sup>3</sup> Some have emphasized the high incidence of

\* Presented in part before the District of Columbia Tuberculosis Association, April 29, 1941.

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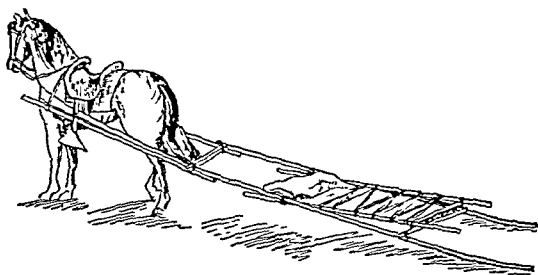


Fig. 217.—Transporting patient by one-horse travois. (Olson, "Improvised Equipment.")

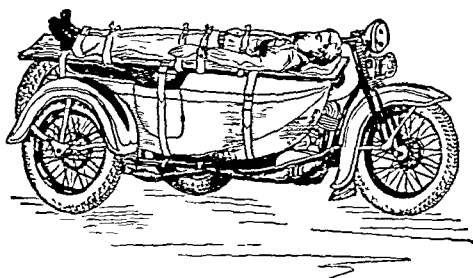


Fig. 218.—Transportation of patient using a padded board attached to sidecar of motorcycle. (Olson, "Improvised Equipment.")

It does not matter, now, as to whether or not these statistics truly indicated an increase in the incidence of tuberculosis. At least, we know that the diagnosis of pulmonary tuberculosis has accounted for a tremendous number of days lost to Army service and a tremendous expenditure on the part of our Government. Certainly, there should be no question as to the importance of searching thoroughly for active or unstable lesions of tuberculosis in our efforts to determine the physical fitness of candidates for the Army.

#### IMPORTANCE OF ROENTGENOGRAPHY IN THE DIAGNOSIS OF CHEST LESIONS

When mobilizing for World War I, and generally in the past, examinations of the chest were accomplished in the conventional manner, reliance being placed mainly upon observation, palpation, percussion and auscultation. Roentgen studies were relegated to a position of secondary or at most auxiliary importance. Quoting one authority of those days:<sup>5</sup> "As compared with the physical examination, the roentgenological examination, even when done by experts, occupies a place of secondary importance in the diagnosis of tuberculosis of clinical significance."

It has been only during the past five years that doctors everywhere have come to recognize roentgenography as the most trustworthy method of studying the chest. This is particularly true when examinations of large groups are involved. Quoting Fellows and Ordway:<sup>6</sup> "If one can assume that the x-ray examination reveals 100 per cent of the lesions of pulmonary tuberculosis our results are: revealed by x-ray, 100 per cent; revealed by fluoroscopy, 87 per cent; revealed by physical examination, 36 per cent; revealed by symptoms, 33 per cent."

On July 23, 1940, the committee on tuberculosis of the Division of Medical Sciences of the National Research Council,<sup>7</sup> recommended to the Surgeon General of the United States Army that a roentgenogram of the chest be made of each registrant, supplemented by a physical examination and laboratory study as indicated. This committee explained that their recommendation was based upon the following facts:



tuberculosis in our southern camps such as Camps Kearney and MacArthur. A large proportion of the men in those camps had come from tuberculosis centers. It was thought that laxity in their physical examinations accounted for "health seekers" being admitted and that a certain percentage of this sharp increase in admissions was due to cases such as these. Others have claimed that many of the reported cases represented exaggerations of symptoms and that the diagnosis "pulmonary tuberculosis" was used too recklessly. During 1919, thousands of men were returned from France with this diagnosis. Among

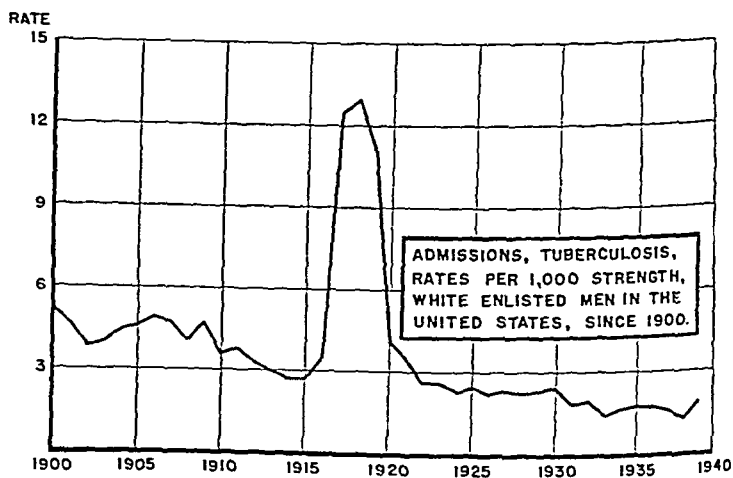


Fig. 219 (From Annual Report of Surgeon General, U. S. Army, 1940.)

many in this group, detailed examinations, which were made in hospitals here in the United States, failed to substantiate the diagnoses in 50 per cent or more of the cases. Dr. Richard Cabot<sup>2</sup> summed up his observations, obtained in Base Hospital No. 6 at Bordeaux, France, thusly: "(1) Pulmonary tuberculosis was of rare occurrence among the sick treated at Base Hospital No. 6. (2) It occurred chiefly among soldiers who had not been specially examined in the training camps of the United States with reference to its presence. (3) Few, if any, cases could have been considered as originating in line of duty. No incipient cases were recognized."

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(1) At least seventy-five (75) per cent of early active tuberculosis can be discovered only by  $x$ -ray examination.

(2) About one per cent of the male population of military age has active tuberculosis, most of which can be detected only by  $x$ -ray examination.

(3) A high proportion of cases of early tuberculosis detectable only by  $x$ -ray examination are likely to break down under such strain as that entailed by military duty, incapacitating them for further service and making them a menace through contagion to their comrades.

(4)  $x$ -Ray examination is more expeditious than physical examination, thereby saving considerable time in the general examination.

(5)  $x$ -Ray film examination furnishes a permanent and authoritative record which may be useful in subsequent medicolegal adjustment.

(6) Conditions other than tuberculosis which would make the registrant unfit for military duty may be discovered by  $x$ -ray examination.

This procedure will amply repay the cost by saving of effective military man power, and reducing the ultimate cost to the Federal Government in pension.

### METHODS OF EXAMINING THE CHEST BY $x$ -RAY

Today, roentgen examination of the chest might be accomplished in a number of ways:

1. Stereoscopically, using conventional 14 by 17 inch film roentgenograms
2. Single exposure studies, using 14 by 17 inch films.
3. Two-exposure studies, using 14 by 17 inch paper roentgenograms.
4. Single exposure studies, using 14 by 17 inch paper roentgenograms.
5. Stereoscopic miniature films, using 4 by 5 inch films for photography of the fluoroscopic image.
6. Single miniature films, using the same film and procedure as in (5).
7. Stereoscopic miniature films, using 35 mm. films for photography of the fluoroscopic image.
8. Single miniature films, using the same film and procedure as in (7).
9. Fluoroscopy.

Oftentimes, large scale examinations of this sort in civil life are devoted entirely to case-finding. Such studies are likely to be made independently, and it is not usually necessary to coordinate the  $x$ -ray examination with other phases of a general examination. Moreover, preservation of the film records may not be at all important.

**Evaluation of Methods on Basis of Our Special Needs.**  
—Our responsibilities are quite different from those just enumerated. True enough, our primary purpose is to identify active or unstable lesions of pulmonary tuberculosis and other conditions which might be cause for immediate rejection. Certainly, we must obviate the inclusion of men who would serve to disseminate disease. In addition to this we must provide

records—*graphic records*—which can be studied by examiners other than those immediately associated with the induction examining board. There will be reviewing boards, possibly pension boards, and these might be located in one or another part of our United States. Therefore, we must anticipate the requirement of sending these film records about the country and we must adopt a method which will permit segregation of records and their easy filing with other records pertaining to the individual.

Many of these records will likely be studied years following the examination. They must therefore be *durable*. They must provide for an *indisputable trust*, for in some instances they will serve as legal evidence. In this respect, we must consider the possibilities of controversy where parenchymal lesions are overshadowed by the densities of ribs or of the heart, spine or diaphragm. Likewise, we must eliminate insofar as possible the confusion due to *artefacts*, which are inevitable when so many individuals are studied each day. The confusing appearance produced by movements of the pulmonary vessels must be overcome.

*Two-exposure Studies Are Indicated.*—Such problems as mentioned speak for a *two-exposure* study of each individual and, more than that, for obtaining *stereoscopic* projections. It is not mandatory that the films be studied by third-dimensional projection, but it is important that the x-ray tube be shifted between the two exposures (in order to reveal the topographical relations of any suspicious densities which might be visualized). We must be cognizant of the tremendous number of examinations involved.

Considering our immediate training program, it is estimated that approximately 4,000,000 individuals are to be studied. These studies should be accomplished before they are admitted into the service and, if they serve in the Army, again before their dismissals. Allowing two-film studies (as a minimum) for each of these examinations, there would be involved approximately 16,000,000 films. Thus, the unit cost per examination compels some thought. It is realized that the expenses concerned with the care of the active cases of pulmonary tuberculosis (and these expenses multiplied because of dis-

seminations of the infection by each active case) will greatly offset the cost involved in any program which might be directed toward prevention. However, the enormous numbers of films involved in our program compel us at least not to be extravagant. The initial cost of equipment might be considered to be of relatively little importance.

*Comparison of Methods.*—Statistical analyses covering all of these aspects are not now available. It is therefore necessary to evaluate the several methods of roentgenological study in

TABLE 1

METHOD	DIAGNOSTIC TRUST	PRESERVING OF GRAPHIC RECORD	EXPEDITING OF THE EXAMINATION	AVAILABILITY OF SUPPLY	INITIAL COST OF AUXILIARY EQUIPMENT	UNIT COST PER EXAMINATION	EASE OF STUDYING
X-RAY FILM 14×17 STEREO	1	4	6	1	CANCELLED	\$1.08	3
X-RAY FILM 14×17 SINGLE	3	3	4	1	CANCELLED	54¢	3
X-RAY PAPER 2 EXPOSURES	3	4	5	1	CANCELLED	68¢	3
X-RAY PAPER SINGLE	4	4	4	1	CANCELLED	34¢	3
FILM 4×5 INCH STEREO	2	1	3	3	\$2600	10-12¢	1
FILM 4×5 INCH SINGLE	6	1	3	2	\$2200	6-8¢	2
FILM 35 M.M. STEREO	5	1	2	2	\$2000	11-13¢	1
FILM 35 M.M. SINGLE	7	2	2	2	\$1400	1-2¢	2
FLUOROSCOPY	8	NONE	1	1	CANCELLED	NEGLECTIBLE	4

♦ AS OF APRIL 1, 1941

‡ ESTIMATED ON THE BASIS OF AVERAGE DISCOUNTS PLUS ALLOWANCE FOR CHEMICALS.

COMPARISON OF METHODS OF CONDUCTING  
ROENTGENOLOGICAL STUDIES OF THE CHEST ON A LARGE SCALE.

a more or less relative manner. In doing so, it is realized that personal opinions do influence the findings, but in assembling them (Table 1) every effort has been made to reflect the opinions of various authorities.

*The Advantages of Miniature Films.*—Particularly with consideration of "diagnostic trust," this evaluation of methods is based upon individual case studies—studies as they might be conducted in a hospital or a clinic where ample time might be taken for deliberation, re-examinations and special tests. Our program calls for analyses of 200 to 400 roentgen images

by any one roentgenologist, in a day. It is questionable whether the ratings of trust given in the table could be applied if analyses of large dimensional images were used, routinely, on such a large number of cases. It must be realized that the scope of visual concentration is quite limited and a study of a 14 by 17 inch film is comparable, in this respect, to viewing no less than six or eight of the miniature films. Photography of the fluoroscopic image provides concentration of radiographic densities. Personal experience in this work has indicated that many early lesions of reinfection tuberculosis, for instance, are made more conspicuous on the miniature film than when projected onto the larger dimensions of conventional x-ray films. The actual significance of these densities might not be immediately apparent, but, owing to the reduction factor, abnormalities are more readily discernible at a glance. Our first requirement is merely that we segregate these abnormalities.

Initially, we are concerned with a *screening* procedure—a *case-finding* procedure—and it is on this basis that we should evaluate our findings. Our duty is not essentially diagnostic, but large film studies (stereoscopic, oblique and lateral views) should be obtained whenever the preliminary findings are doubtful. The matter of continued alertness and ease of viewing must be considered. Since viewing of the small dimensions requires fewer fields of visual concentration and since the concentration of densities provides for making them more conspicuous, for our purposes of screening and case finding, miniature films are considered best.

#### THE ROENTGENOLOGICAL SCREENING PROCEDURE PHOTOROENTGENOGRAPHY.

**Technic.**—The roentgenological screening procedure ("reduction roentgenography," "photofluorography," "photoroentgenography," etc.) is based upon recording photographically the image produced upon a fluoroscopic screen. The candidate stands in front of the fluoroscopic screen and is positioned in the conventional manner. An x-ray exposure is made, the rays being directed through the candidate and becoming effective upon the fluoroscopic screen. A lens or camera arrangement incorporated on the fluorescent side of the screen, and properly pro-

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*Lens.*—It is desirable that the lens of this unit have a uniform refractory power of approximately F 1.5. With such a lens, when using a focal-fluoroscopic screen distance of 40 inches, the exposure required for these chest studies is little more than that required for standard 6-foot chest studies (provided a suitable fluorescent screen and film be used). With the use of lenses of slower refractory powers, as for instance a lens of F 2.0 or slower speed, the exposure requirements are more than doubled, thereby inflicting considerably greater punishment upon the x-ray tube with concomitant expectations of shorter tube life.

*Films.*—The film should have the smallest grain size possible, otherwise unsharpness of detail will result. The reduction factor does not offset the disadvantages of large grain in the film emulsion, as it does in the fluorescent screen emulsion.

Recording of the fluorescent image is essentially a photographic procedure and not a radiographic one. Consequently, only the principles and practices of photography are involved. It is advisable that the sensitized film have an emulsion which is coated on *only one side* of the transparent support—rather than that it be a duplitized film as used conventionally in x-ray work. It should possess a non-halation backing. Since fluorescent rays are rays of visible light they are subjected to deviations in direction when passing through a front layer of film emulsion and through the film support, finally to become effective upon a second layer of emulsion. This accounts for considerable unsharpness of detail when using duplitized x-ray films for photographing the fluoroscopic image. To some extent, this result is seen in the use of duplitized films with conventional intensifying screens, in ordinary roentgenography, but when applied to photoroentgenography, because of the miniature dimensions of the total image, the relative degree of unsharpness is of greater importance.

To meet our requirements of almost automatic coordination with the other members of the technical examining team, it is advisable that the two projections made of each candidate be included on one film. For the 4 by 5 inch work, this can be accomplished by the use of a 4 by 10 inch film. Particularly with smaller miniatures, this might be accomplished with the



ected against extraneous light, provides for recording the image (Fig. 220).

**Apparatus Requirements.**—The camera unit consists essentially of a fluorescent screen, a lens, a film holder, a light-proof compartment enclosing these and a supporting column. The  $x$ -ray machine unit, itself, might be of standard design or modified for adaptation to this unit.

**Fluorescent Screen.**—At present, there is no unanimity of opinion as to the best type of fluorescent screen. Some of the screens in use today fluoresce wave lengths of the blue-violet

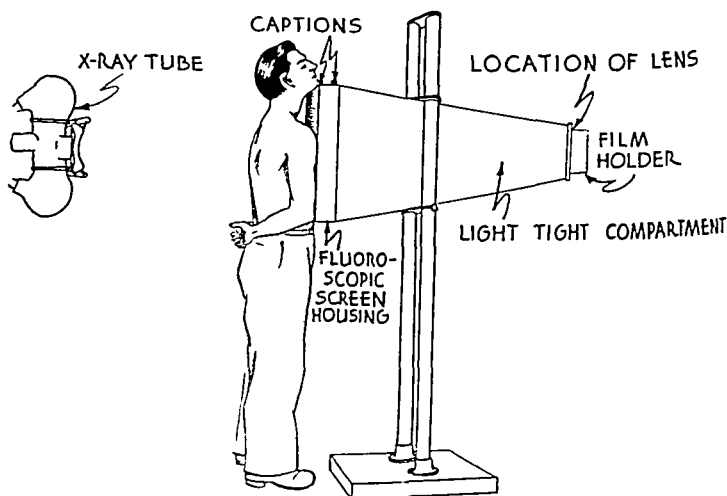


Fig. 220.—Photography of the fluoroscopic image.

range while others fluoresce wave lengths of the yellow-green range. The wave lengths of the fluorescent rays determine the type of film which should be used, and vice versa. Some concern has been mentioned relative to the size of crystals contained in the fluorescent screen. In the case of certain screens, it is true that the greater the intensity of fluorescence, the larger is the dimension of the crystals. Because of the factor of reduction—as utilized in this type of work—the size of the crystals of the fluorescent screen is unimportant, provided the films are viewed in relatively small dimensions which are considerably less than those of the fluoroscopic screen image.

is not discernibly different from that obtainable when using a tube with a large focal spot. With consideration of heat unit capacity and relative costs, plus the fact that we must anticipate making two exposures per minute, it is considered practical to use a stationary anode tube having an effective focal spot dimension of no less than 5 mm. square as projected. A stationary anode tube of smaller focal spot dimensions cannot be expected to withstand the rapidity of the heavy loads required, particularly when stereoscopic pairs are to be obtained.

**Grid.**—In order to provide for sufficient contrast where secondary fog would otherwise obscure the detail, it is advisable that, for chests having a measurement of 23 cm. or more, a wafer grid be placed in front of the fluoroscopic screen. The standard U. S. Army portable grid serves well for this purpose. With it, it is merely necessary to increase the milliamperesecond value to twice that which would be used without it. However, even the double milliamperesecond value means considerable increase in x-ray tube punishment. After accomplishing the exposures required for a large-chested individual, it is advisable to allow one or two minutes before proceeding with further exposures.

**Film Processing Equipment and Method.**—Because we expect to utilize large film roentgenograms for some cases, it is practical to provide standard film processing equipment. Even with 35 mm. films the processing can be accomplished with standard film hangers and standard 2 to 5 gallon insert tanks. The time-temperature method of processing should be followed so that uniformity of results may be assured. With improvements of chemicals, the time required for developing might be reduced to three minutes (though six minutes may be given, with reduction of 3 to 6 kilovolts in the exposures—as compared with regular technic); the intermediary wash should not require more than a few seconds; fifteen minutes should be allowed for adequate clearing and hardening in the fixing bath and the films should be washed in fifteen minutes. The time required for drying will depend to some extent upon the design of the film hanger.

**Study of Wet Films.**—When stereoscopic viewing is to be accomplished, the films should be thoroughly dried. However,

use of a roll type of film. These provisions lessen confusion in the darkroom and prevent a "bottleneck" which might otherwise occur because of having to match the two exposures taken of each individual. The services of an extra technician are thus saved.

*Film Holder.*—In order to provide for true stereoscopic projections it is important that provision be made for automatic shifting of the film. The direction of this shifting must be coordinated with respect to the direction of the movement of the x-ray tube and the design of the stereoscopic viewing apparatus; otherwise, only "pseudo-stereoscopic studies" will be obtained. Hence it is important that the design of the film holder be such as to provide for movement of the film, either upward or downward, unless it be adapted to a single design of x-ray tube supporting column. Electromagnetic or remote control of the film shifting should be coordinated with remote control of the x-ray tube shift in order to accomplish satisfactory results, obtaining two exposures within the time limits during which the average individual is able to withhold breathing.

*Milliamperage Capacity of the Unit.*—It is preferable that a unit of high milliamperage capacity be used. If the exposures are made with milliamperages of 400 or 500, the exposure time can be reduced to values whereby movements of the pulmonary vessels and voluntary movements will not be troublesome. Lower milliamperages may be used; in fact milliamperages as low as 30 have been employed (with the focal-fluoroscopic screen distance reduced to 30 inches), though in such cases the exposure time must necessarily be increased—with the attendant disadvantages. It has been found practical to make use of 200 milliamperes full wave rectified equipment. Particularly when utilizing an x-ray generator at its rated capacity load, it is important that the regulation of the transformer be such that its wave form be not distorted at the high milliamperage settings, so that the radiation performance will be truly consistent with the milliamperage.

*Focal Spot Dimensions of the x-Ray Tube.*—Because of the reduction factor, the dimension of the effective focal spot of the x-ray tube is not important. The detail obtainable when using a small focal spot such as that of a rotating anode tube

genologist. The activities of these assistants might be as follows:

1. *Secretary and Filing Clerk.*—The duties of this assistant would include general secretarial work such as recording of interpretations, filing of the records and handling of correspondence.

2. *Captioning Stenographer.*—The duties of this assistant would be similar to those of assistant No. 1. In particular though, he or she would record the data as reported by each individual, and type the identifying captions. It is estimated that roentgenography of 200 individuals (400 exposures) can be accomplished within a period of four hours. If this number were admitted in a steady line, this assistant might be borrowed from other activities of the examination center, for such a period of time.

3. *The x-Ray Machine Operator.*—This assistant must be a well qualified x-ray technician. His duties should include not only the handling of the controls of the machine but he must be responsible for the proper maintenance of the equipment and for obtaining satisfactory roentgenographic densities. He should be familiar with a kilovoltage penetration technic and vary the settings of the autotransformer according to the measurements of the chest, as reported to him by No. 4 assistant.

4. *The Positioning Assistant.*—This man should likewise be a well qualified x-ray technician. He should be a "pinch-hitter" in case of disability of No. 3 assistant. When working with the entire team, his duties should consist of positioning the individual and the x-ray tube properly. As the individual advances toward the fluoroscopic screen, this assistant should measure the diameter of his chest (at the nipple level) and proclaim this measurement to the operator of the x-ray machine. He should then carefully position the individual, having him stand so that his toes are 6 to 8 inches in front of the plane of the screen or cassette panel, with his chest leaning forward (so as to expose the apices). He must insure symmetrical approximation of the chest and rotate the upper extremities so as to clear the scapulae from the thorax as much as possible. The cassette or screen should be raised high, extending the

for direct viewing, the wet films can easily be handled and it is neither impractical nor annoying to study them in that condition. If this is done, a report of the films can be made within one-half to three-quarters of an hour following the time of making the exposures, thus enabling the roentgenological team to coordinate very closely their activities with those of the other examiners.

**Film Captions.**—To provide for adequate identification of the films, two captions should be used. The characters of these captions should be of a vertical dimension of no less than  $\frac{1}{4}$  inch. Their style should be of plain bold-faced capital letters such as those of "Bulletin" type; otherwise reading of them may be difficult after reduction to the dimensions of the miniature films. Caption slots should be provided on the housing of the fluorescent screen and detailed information should be recorded. This might be accomplished with the use of two small captions above the shoulders, utilizing the spaces of the screen and film. One of these captions should include the following information: location of the examination; examining board number; date and orientation as to the side of the body. This caption may serve for all the examinations conducted during any one day. It may be left in place, either in the upper right- or the upper left-hand corner, depending upon the arrangement of the room and ease of handling the other captions. The other caption should include: name of the candidate (last name, first name and middle initial); street address and locality of residence; local board number; color, age, height and weight. The following are sample captions:

**CAPTION 1**

Station Hospital,  
Fort Sam Houston, Tex.,  
Army Examining Board No 54,  
December 12, 1941,  
Left.

**CAPTION 2**

Benninghaven, Otis D.,  
1543 Hanover St.,  
Dallas, Tex.,  
Local Board No 169,  
W, 32, 68, 154

**PERSONNEL**

When close coordination with other members of an examining team is required and when several hundred individuals are to be examined in a day, it is recommended that the x-ray team consist of at least six assistants. in addition to the roent-

assistants 1 and 2 might be consolidated as well as those of assistants 3, 4 and 5, leaving a team of three assistants plus the roentgenologist which might function without difficulty.

#### EVALUATION OF THE ROENTGEN FINDINGS IN PULMONARY TUBERCULOSIS

The success of this entire program depends upon a scientific evaluation of the findings. Mere search for typical pictures of pathology will lead to too many mistakes—errors in recognition of important lesions; errors due to exaggeration of the unimportant. Very conspicuous lesions may be unimportant whereas relatively inconspicuous changes may be cause for rejection or for treatment. Interpretations must depend upon an orderly sequence of analyses: consideration of the soft tissues, the bony thorax, the pleurae, the diaphragm, the lung parenchyma, the hilar lymph nodes, the cardiac silhouette and, finally, the trachea and mediastinum. Tangible roentgen criteria relative to any of these must be tabulated, at least mentally, and decisions must be based upon deductive reasoning substantiated by definite findings.

The range of diagnostic possibilities is protean. It is not within the scope of this paper even to list the gamut of recognizable entities which must be considered. These are well known to qualified roentgenologists. Our Army Regulations list warnings as to certain causes for rejection. Reference is directed to the following: MR 1-9, Standards of Physical Examinations during Mobilization; AR 40-100, Standards of Miscellaneous Physical Examinations; AR 40-105, Standards of Physical Examinations for Entrance into the Regular Army, National Guard and Organized Reserves.

Since pulmonary tuberculosis is the particular problem with which the Army is concerned, during times of mobilization and demobilization, details which pertain to the roentgenological aspects of this disease are to be emphasized. The Surgeon General of the United States Army has in a general way adopted the classification proposed by the National Tuberculosis Association.<sup>5</sup> Two phases of tuberculosis are recognized: the *primary or initial phase* and the *reinfection phase*. Certain characteristics quite definitely distinguish these two phases.

chin of the candidate, and then the focal spot of the x-ray tube should be aligned to the center of the field—shifting either way from the center, for stereoscopy. Routinely, the long axis of the x-ray tube should be perpendicular to the floor, with the cathode end up,<sup>7</sup> so as to provide for the greatest radiographic intensity through the apices and through the captions. Before the exposures are made, No. 4 assistant should step away from the tube and preferably behind a lead screen so as to avoid unnecessary x-radiation exposure (the accumulation of minimal leakages which are to be expected even through modern ray-proof housings).

5. *The Film Handler*.—This assistant should obtain the caption of each candidate as he advances toward the radiographic unit. He should remove any caption already present, and replace it with the one pertaining to the individual. While the candidate is being positioned by assistant No. 4, he should prepare the film for the first exposure. If automatic shifting is not provided, it will be necessary to change the film manually between the two exposures. In such a case a lead screen should be provided and located adjacent to the film holder so as to protect this assistant against unnecessary x-radiation and yet permit him to be sufficiently close to the film holder to arrange for changing of the film (within reasonable time limits of holding one's breath). This assistant should also accomplish a liaison between the exposure room and the processing room and between the processing room and the viewing room or office for interpretation. With the roll type of film many of these services become unnecessary.

6. *The Film Processor*.—This assistant will be responsible for loading and for unloading all films as well as for processing them. He must expedite all phases of the processing, avoiding unnecessary delay particularly during fixation and washing so that the films can reach the roentgenologist within the one half to three quarters of an hour following the actual exposure.

It is apparent that with a considerable rush of activities, the services of an additional assistant may be necessary—particularly for coordinating the activities of the processing room and the exposure room or the office. With lesser activity, the number described above may be superfluous. The duties of

channels. This phase is usually manifested, therefore, by *strandlike densities* which extend according to bronchial arborizations and which are therefore likely to be found in the peripheral thirds of the lungs. Particularly, if this type of lesion is found in the apices or in the retroclavicular regions, it is most likely a manifestation of the reinfection phase.

**Prognosis in the Two Phases Compared.**—The average prognosis of the *primary phase* of tuberculosis is quite different



Fig. 222.—Pulmonary tuberculosis, reinfection phase, minimal, involving the peripheral portion, lower third of the right upper lobe. Note the contraction of the ribs of the upper right thorax, the characteristic strandlike densities in the basal portion of the right upper lobe, the pattern of arborization involving the peripheral portions of this region, the retroclavicular position of the lesion and the relative lack of lymph node reaction. The fuzzy pattern of this lesion indicates activity. These findings must be considered as basis for disqualification.

from that of the reinfection phase. Unless extensive, a primary lesion usually involutes, with calcification and substantial fibrosis. The calcification occurs after necrosis of tissue. Evidence of it simply indicates considerable reaction on the part of the individual, and a protective fibrosis is usually found concurrently with it. After retrogression, recurrent activity of these lesions is reasonably unlikely.



**Primary Phase.**—The primary phase (Figs. 221, 223 and 224) is characterized by *lymph node involvement*; it may include one or more *pneumonic consolidations*. The involved lymph nodes may be located in the cervical region or they may be located in the intermediary zones of the lungs, but more frequently they are found in the hilar regions or in the vertebral gutters. Pneumonic processes are usually located in the hilar



Fig. 221.—Pulmonary tuberculosis, primary phase, showing the acute stage. Note the several small, localized, pneumonic consolidations and the very large lymph nodes in the right hilum and the right paratracheal region. Such findings must serve for disqualification.

or intermediary thirds of the lung fields, though occasionally they are found in the very periphery of the lungs. There may be several pneumonic processes and, in fact, actual miliary lesions may be developed in the primary phase.

**Reinfection Phase.**—In contradistinction, the reinfection phase (Figs. 222, 225 and 226) is characterized by an infiltrative process which is essentially concerned with the lung parenchyma or with the bronchi and the peribronchial lymph

an apparent cure,<sup>4</sup> while no more than 4 per cent of primary lesions break down, within the age groups of military personnel.

**Particular Findings Leading to Rejection or Acceptance for Service.**—Any evidence of *activity of a primary lesion* is cause for rejection. Activity might be manifested by a soft tissue density outlining a pneumonic consolidation or it might be manifested by the outline of enlarged lymph nodes. In either case, mere *stippling of calcific density* should be

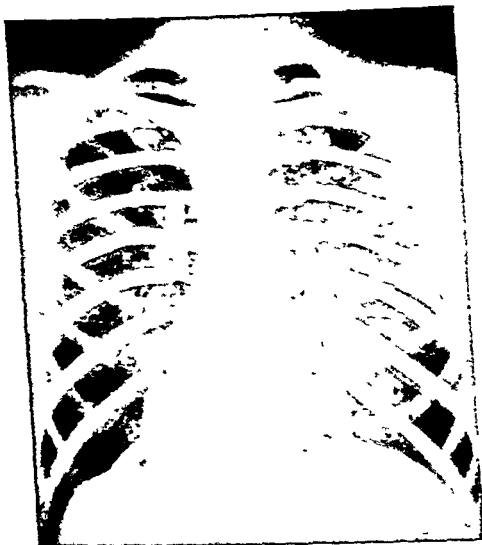


Fig. 224.—Pulmonary tuberculosis, primary, multiple, apparently stable. Note the several large calcific densities in the left hilar region. Because several of these are more than 1.5 cm. in diameter and because of there being more than five of them, contained within lymph nodes, regardless of the apparently substantial healing processes concerned, it is advisable to reject such a case.

considered as an indication of an unstable lesion and cause for rejection, temporarily. Likewise, lesions which show a *central calcific density* with a periphery of lesser tissue densities ("perifocal reaction") should be considered uncertain as to healing and the individual should be disqualified, at least temporarily. Actual *cavitation* might be found during the primary phase: such evidence should be considered indicative of activity and therefore disqualifying.

The type of reaction to a *reinfection lesion* is usually quite different. Here, fibrosis ordinarily occurs before autolysis and calcification of the lesion, and the type of fibrosis may be only partially protective. Moreover, the mere fact of reinfection signifies inability on the part of the individual to resist the second invasion or extension of a process. Though overwhelming infection or the depletion of bodily reserves may be respon-

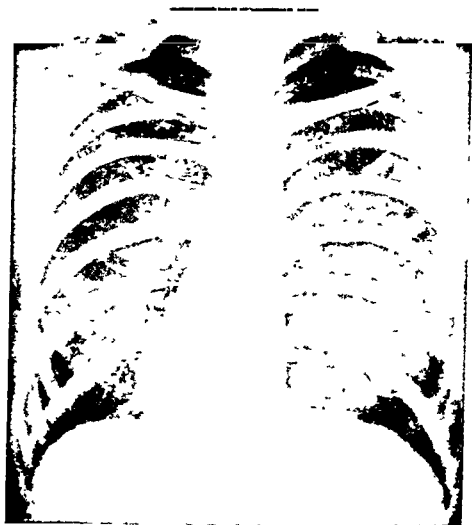


Fig. 223.—Pulmonary tuberculosis, primary phase, unstable, involving the peripheral third of the left lower lobe. Note the heterogeneous type of density outlining the lesion which is located in the lateral portion of the eighth interspace. The center of this lesion shows some calcification while the peripheral portions of it appear "softer"—there being a fading of its density. Such a lesion should be considered "unstable," and even though it be a primary lesion and though its size be small, such evidence should be considered basis for rejection.

sible, further reactivation of reinfection lesions is to be considered as not unlikely. The incidence of breakdown of these lesions is dependent upon the care given in the case and the type of existence of the individual, but the relatively poor prognosis of reinfection cases as compared with primary cases is seen in the fact that approximately 30 per cent of individuals with reinfection lesions require further hospital care following

basis for disqualification. Later acceptance of an individual having very minimal lesions might be possible, if after a period of six months there is found to be neither progression nor regression of the lesion. Such final acceptances must be limited to a very small percentage of these cases, for the extent of these lesions must not exceed in dimensions a volume of lung parenchyma such that when projected onto a standard 14 by 17 inch roentgenogram the involvement will be confined to an

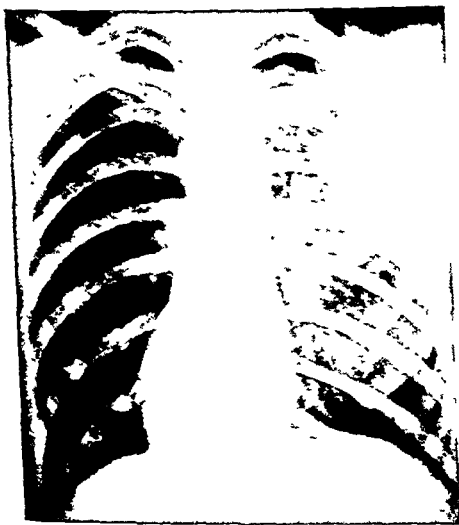


Fig. 226.—Pulmonary tuberculosis, reinfection type, moderately advanced. These were the findings in the case shown in Fig. 225, approximately eight months following the candidate's admission into Army service. This case emphasizes the importance of analyzing relatively inconspicuous evidence.

area no greater than 5 sq. cm. Reinfection lesions are characterized by *strandlike densities*. Lymph node enlargements are not a part of their picture. Their pattern may appear merely as exaggeration of the normal pulmonary markings or as nodulations and definite consolidations.

Prominent *pulmonary markings* seen in the film because of underexposure or because of movements of the pulmonary vessels, must not be confused with tuberculous processes. In contradistinction, reinfection lesions are generally localized;

*Calcific lesions* which are homogeneously dense might be acceptable provided their dimensions are not too great and provided there are not too many of them. In order to provide for uniformity of decisions, arbitrary limits are cited as follows: there may be as many as five of these lesions located in lymph nodes but the dimensions of any one must be no greater



Fig 225.—Pulmonary tuberculosis, reinfestation phase, minimal, involving the midportions of the right lung. Note the contraction of the right thorax and the very delicate infiltrations in this region. One may question there being actual involvement, the strands may appear merely as exaggerated pulmonary markings, yet when considering the pulmonary markings in other portions of the lungs, the markings in this region do appear conspicuous and the area of involvement can be delimited to an arborized course. These relatively insignificant findings are likely to be ignored and they were ignored. This candidate was admitted to the service and, within a period of eight months, the small lesion blossomed into a moderately advanced process, as shown in Fig 226. No doubt, this man will be pensioned for the rest of his life.

than 1.5 cm. In addition, there may be as many as five such lesions contained in the lung parenchyma but, of these, no more than one may be as large as 1 cm. in greatest dimension while the others must not be greater than 0.5 cm. in greatest dimension.

Any evidence of a *reinfestation lesion* must be considered

present evidence of instability or of having healed, must be considered disqualifying. In view of the responsibility assumed by the Government, we must consider not only prognosis and the probabilities of breakdown but we must also consider the possibilities of claims being made later merely because of the discovery of the presence of lesions.

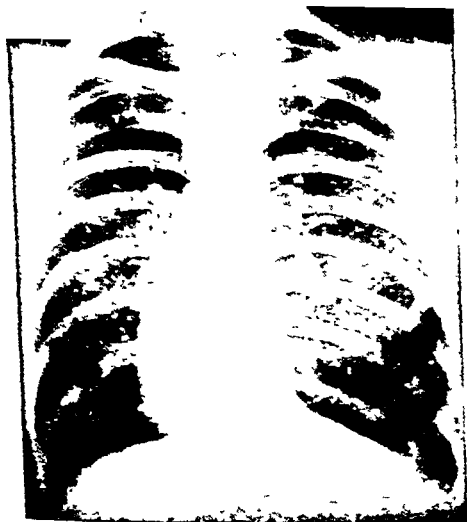


Fig. 227.—Pulmonary tuberculosis, miliary, apparently stable. Note the distribution of more or less uniform calcific densities scattered throughout all portions of both lungs. Also note the conspicuous calcific densities in the hilar lymph nodes. It is likely that the spread of the organisms occurred during the primary phase of involvement and that this individual had manifested unusual resistance by overcoming this invasion. Nevertheless these findings are considered a basis for rejection because of claims which might be made in case the individual learns of these lesions. Moreover, since so many lesions are demonstrated in the lungs, there is a probability of there being lesions in other organs as well and reactivation of some of these is possible.

In general, a disqualification which is based upon a diagnosis of a reinfection phase of tuberculosis will usually be permanently effective, whereas a disqualification which is based upon a diagnosis of an unstable primary lesion provides for later re-examinations and possible acceptance.

Table 2 is presented to emphasize acceptable versus unacceptable criteria. It must be emphasized that the clinical as-

the fuzzy markings which depict them are not usually distributed uniformly throughout the entire lung fields, except in extreme degrees—which would be readily recognized. Reinfection lesions usually follow a bronchial division and therefore, even in their earliest stages, they should be identified after glancing over other portions of the lung fields and noting the more delicate pattern of the normal lung as compared with the coarsened and fuzzy pattern of an early involved portion.

*Cavitation* might occur either during the primary phase or during the reinfection phase. Regardless of the size of any cavities, they should be considered cause for rejection. However, rather than to misinterpret superimposed pulmonary markings which might present the appearance of cavitation, it is always important to visualize a cavity thoroughly by obtaining projections from various angles; utilizing obliques, laterals and stereoscopic studies and films of standard dimension, if necessary.

Mere evidence of a *pleural cap* (i.e., thickening of the pleura over the apex of either lung) or of diaphragmatic tentings should not be considered cause for rejection unless there are found, extending from either of them, definite parenchymal lesions. Then, evaluation of the findings should be based upon identification of the phase of the disease process. Widespread *pleural thickenings* should be considered cause for rejection provided their etiology is not attributable to a nontuberculous episode and provided the thickenings be such as to possibly obscure a dormant infection.

The above descriptions have been limited to more or less borderline cases where some doubt might exist as to whether an individual should be accepted or disqualified. *Moderately advanced* or *far advanced lesions* of reinfection tuberculosis would likely prevent any individual from being sufficiently active to be examined for service in any branch of the Army, and in the case of those already in the service, the diagnosis would likely have been established during earlier stages. At least, these more developed processes would readily be recognized and there should be no doubt as to the proper handling of them. *Miliary lesions* (Fig. 227), whether they appear to be of the primary or of the reinfection phase and whether they

TABLE 2—*Continued*

## EVALUATION OF ROENTGEN CRITERIA IN PULMONARY TUBERCULOSIS

	Acceptable for Army Service	Unacceptable for Army Service
<i>Evolution Phase</i> Definitely Active		<ol style="list-style-type: none"> <li>1. <i>Hazy strandlike and diffusely nodular densities</i> in the lung parenchyma.</li> <li>2. <i>Bronchopneumonic</i> or <i>lobar consolidations</i>.</li> <li>3. <i>Cavitations</i>.</li> <li>4. <i>Pleural effusion</i>.</li> <li>5. <i>Hydrothorax</i>.</li> <li>6. <i>Pneumothorax</i>.</li> </ol>
Unstable		<ol style="list-style-type: none"> <li>1. More or less <i>sharply demarcated strandlike densities</i> infiltrating a volume of lung parenchyma which when projected on to a standard 14 by 17 inch roentgenogram would measure more than 5 sq. cm.</li> <li>2. <i>Pleural thickenings</i> of such degree as possibly to obscure a dormant infection.</li> </ol>
Questionable Stability	<ol style="list-style-type: none"> <li>1. <i>Sharply demarcated strandlike densities</i> infiltrating a volume of lung parenchyma which when projected on to a standard 14 by 17 inch roentgenogram would measure less than 5 sq. cm. <i>and which has shown no progression or regression in size or appearance after an interval of six months.</i></li> </ol>	<ol style="list-style-type: none"> <li>1. Sharply demarcated strandlike densities, as above described, but involving less volume of lung parenchyma. Such cases should be restudied after an interval of six months.</li> </ol>

## SUMMARY

In conducting examinations of candidates for the United States Army, it has been emphasized that particular efforts should be directed toward recognizing active as well as unstable lesions of tuberculosis. Today, roentgenological studies are recognized as providing the most trustworthy means of identifying these cases. Nine possibilities of roentgenological procedure are suggested. Because later reference to the initial studies may be required, it is believed that a graphic (film)



pects of any doubtful cases must be considered. The criteria listed pertain to cases where explanations cannot be based upon pyogenic pneumonic processes or upon a background of infections other than tuberculosis.

TABLE 2

## EVALUATION OF ROENTGEN CRITERIA IN PULMONARY TUBERCULOSIS

(These arbitrary delimitations are cited to provide for uniformity of decisions.)

	Acceptable for Army Service	Unacceptable for Army Service
<i>Primary Phase</i> Definitely Active		<ol style="list-style-type: none"> <li>1. <i>Pneumonic consolidation</i>—isolated or few (usually located in hilar or midzones) possibly lobar or miliary.</li> <li>2. <i>Enlarged lymph nodes</i> (usually located in hilum; possibly paratracheal, midlung zones or cervical).</li> <li>3. <i>Cavitation</i>.</li> </ol>
Unstable		<ol style="list-style-type: none"> <li>1. <i>Residual parenchymal consolidation</i> (possibly showing central calcific density but periphery of less density).</li> <li>2. <i>Stippling of calcific densities</i> (either in parenchymal lesions or in lymph nodes).</li> </ol>
Stable	<ol style="list-style-type: none"> <li>1. <i>Parenchymal nodulation</i> (usually calcific in density), provided there be no more than five such and provided no more than one of these has a diameter as great as 1.0 cm; the others having no larger diameter than 0.5 cm.</li> <li>2. <i>Residual lymph node densities</i>—(calcific) provided there be no more than five such and provided none have a diameter greater than 1.5 cm.</li> <li>3. <i>Pleural cap</i>—without underlying parenchymal lesion of significance.</li> <li>4. <i>Diaphragmatic tenting</i>—without overlying parenchymal lesions of significance.</li> </ol>	<ol style="list-style-type: none"> <li>1. <i>Parenchymal nodulations</i>—multiple, more than five in number or where more than one of these has a diameter of 1 cm. or larger.</li> <li>2. <i>Lymph node densities</i>—multiple, more than five in number or where a diameter of any one is greater than 1.5 cm.</li> </ol>



record should be obtained at the initial examination and again before discharge of the individual from the service. In order to provide for a sufficient degree of legal trust, a two-projection study appears mandatory.

These principles indicate that for Army purposes, stereoscopy with the use of miniature films (*i.e.*, photography of the fluoroscopic image) is a most practical procedure. A general description of the method is presented and certain details are cited relative to ideal working conditions. For Induction Board activities the duties of the various members of the roentgenological team are described.

Finally, there is stressed the importance of scientific interpretation of the film studies. Particular reference is made to the primary and reinfection phases of tuberculosis and to the characteristic criteria which might serve to differentiate them particularly in borderline cases. These criteria are described in terms of what should be considered a basis for acceptance and what should be considered a basis for disqualification for Army service.

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irregular conjugation of sulfapyridine, varying from 10 to 90 per cent, it is impossible to predict the amount of sulfapyridine present, although the average is about 35 per cent of the total drug.

For the most part, these compounds resemble urea in their uniform distribution throughout the body, as they diffuse readily into body tissues and fluids. The *tissue* concentrations.

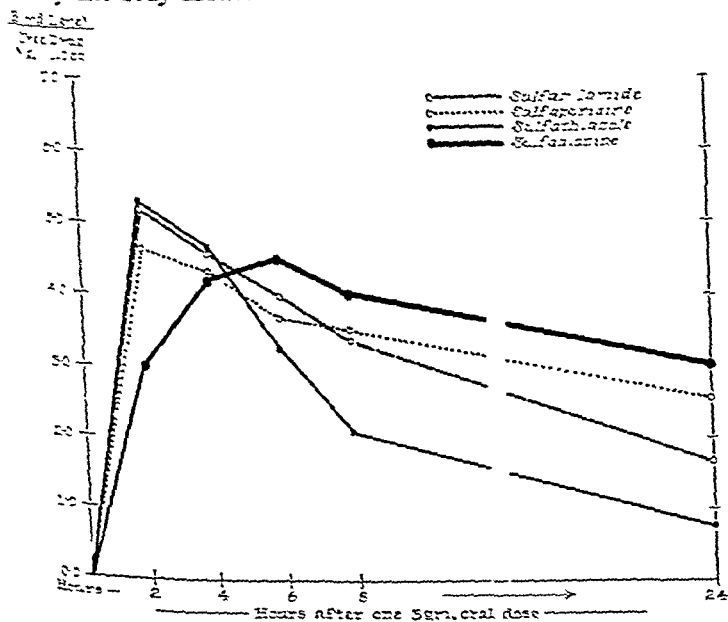


Fig. 218.—Average blood levels of free drug after single oral 5-grm. doses of sulfanilamide, sulfapyridine, sulfathiazole and sulfadiazine. Five different subjects were used to obtain each curve.

however, vary in relation to their vascularity so that diffusion into areas of chronic infection, bone and necrotic tissue may be deficient. All of these compounds are present in *exudates* and *transudates* in concentrations slightly lower than those found in the blood. With the exception of sulfathiazole, they pass readily into the *cerebrospinal fluid* in concentrations averaging 50 to 65 per cent of that present in the blood. Because of the relatively low concentration of sulfathiazole attained in the cerebrospinal fluids—about 20 per cent of the blood level—its

the *situation* of the infecting organisms<sup>1</sup> and the *pathologic character* of the infected tissue. If bacteria are situated in a relatively poor medium for promoting growth, as blood or urine, the drugs are very effective. However, if the bacteria are situated in tissue medium, rich in products of tissue breakdown which favor bacterial growth and inhibit sulfonamide action, the drugs seem clinically to accomplish little more than to protect uninvolved tissue. Therefore, it is important to start chemotherapy early in the infectious process *before pus formation occurs*. If, however, such conditions are present these drugs are not to be employed as substitutes for surgical procedures, but may be used in the hope of preventing a spread of the infection.

### PHARMACOLOGY

**Absorption.**—To employ these drugs intelligently one must possess some understanding of their pharmacologic behavior when administered to man. For practical purposes we may assume that sulfanilamide, sulfapyridine, sulfathiazole and sulfadiazine are all nearly completely absorbed from the intestinal tract into the blood stream within two to four hours after oral ingestion of 3-gm. doses (Fig. 228). After the fourth hour the amount of drug in the blood, with the exception of sulfadiazine, diminishes rapidly. Thus, in order to attain and maintain adequate blood concentration of these drugs it is important to administer a large initial dose, followed by smaller amounts at four-hour intervals day and night until complete clinical cures are obtained. Since irregular or varying concentrations of these drugs in the blood result in diminished therapeutic effectiveness, it is necessary to follow this schedule of dosage if adequate blood levels of the drugs are to be maintained. Because of the behavior of sulfadiazine<sup>2</sup> it is practical to administer this drug at six-hour intervals instead of the usual four-hour schedule.

**Distribution in Body.**—After absorption into the blood stream, the sulfonamide drugs are partially conjugated by the liver into the acetylated or inactive derivative. In general, approximately 20 per cent of sulfanilamide, 30 per cent of sulfathiazole, and 15 per cent of sulfadiazine appears in the circulating blood in the conjugated compounds. Because of the

manifestations observed in hospitalized adults receiving these compounds. Sulfadiazine has been included on the basis of our experience with its use in only 300 patients.

Ambulatory patients complain of *dizziness* rather commonly, especially with sulfanilamide or sulfapyridine therapy. The recognition that dizziness may occur is important, especially with respect to patients who operate machines requiring precision or judgment.

Cyanosis is often observed in patients receiving sulfanilamide and sulfapyridine, but is produced to a lesser degree with the other drugs of this group, and, in general, may be disregarded.

TABLE 1  
TOXIC MANIFESTATIONS OF THE SULFONAMIDES

Reaction	Sulfanilamide	Sulfapyridine	Sulfathiazole	Sulfadiazine
Dizziness . . . . .	Common	Common	Uncommon	Uncommon
Cyanosis . . . . .	Common	Common	Uncommon	Uncommon
Nausea, vomiting . . . . .	30 per cent	60 per cent	18 per cent	4 per cent
Fever . . . . .	9 per cent	3 per cent	5 per cent	3 per cent
Dermatitis . . . . .	2 per cent	2 per cent	4 per cent	1 per cent
Conjunctivitis . . . . .	Not seen	Not seen	2 per cent	Not seen
Psychosis . . . . .	1 per cent	4 per cent	3 per cent	4 per cent
Hematuria—Microscopic . . . . .	Not seen	10 per cent	8 per cent	3 per cent
Gross . . . . .	Not seen	1 per cent	Rare	Not seen but reported
Renal calculi . . . . .	Not seen	Rare	Rare	Very rare
Aciduria . . . . .	Not seen	Rare	Rare	Not seen but reported
Neutropenia . . . . .	1.0 per cent	2 per cent	2 per cent	1.5 per cent
Agranulocytosis . . . . .	Rare	Rare	Not seen	Not seen
Acute hemolytic anemia . . . . .	1.2 per cent	1 per cent	Not seen	Not seen
WBC anemia . . . . .	4 per cent	2 per cent	Rare	Rare
Hepatitis . . . . .	Rare	Very rare	Very rare	Not seen
Neuritis . . . . .	Very rare	Very rare	Very rare	Not seen

The most frequent toxic reactions from these drugs are *nausea* and *vomiting*, usually appearing during the first twenty-four hours of therapy. The vomiting associated with sulfanilamide and sulfathiazole is, as a rule, mild and it rarely becomes so severe as to necessitate stopping drug therapy. However, in the case of sulfapyridine vomiting constitutes a more serious problem and not infrequently it is necessary to stop treatment when it develops. Sulfadiazine causes vomiting in only 4 per

use in meningeal infections has been limited. The low concentration of sulfathiazole in the spinal fluid is not necessarily of great consequence because it is the existence of antibacterial concentrations of drug in submeningeal tissues, curtailing bacterial invasion, which probably limits the spread of the process as much as the drug in the spinal fluid itself.<sup>3</sup> It is, nevertheless, desirable to have a bacteriostatic concentration of drug in the spinal fluid, and, for this reason, sulfathiazole is not recommended for the treatment of meningitis, although good results have been reported<sup>4</sup> with its use in such infections. These compounds, with the exception of sulfathiazole,<sup>5</sup> readily penetrate the red blood cells. This is perhaps of clinical importance as far as the development of hemolytic anemia is concerned.

**Excretion.**—The sulfonamide drugs are excreted mostly in the urine, both in free and acetylated form, and, with the exception of sulfadiazine, excretion of a single dose is complete within twenty-four hours. Their excretion is similar to that of urea, but reabsorption by the tubules occurs to a greater extent, and their elimination is reduced in the presence of kidney damage sufficient to cause nitrogen retention. However, the clearance of these drugs is definitely increased by an increased rate of flow of urine and this is best obtained by forcing fluids, either by mouth or, if necessary, parenterally. With a decrease in kidney function, an increase in drug concentration in the blood occurs, especially of the acetyl fractions. Therefore, should the volume of urine become low, the possibility of stone formation in the urinary tract by precipitation of crystals of the acetyl compounds, particularly acetylsulfapyridine, and acetylsulfathiazole, is greatly increased.<sup>6</sup> Hence, it is extremely important, in order to facilitate the excretion of the acetyl drugs by the kidneys, to maintain an adequate urinary output of at least 1200 cc. daily.

#### TOXICOLOGY

As in the case with many other chemotherapeutic agents, the sulfonamide drugs are not entirely harmless to the host. It is important, therefore, that one be familiar with the untoward effects associated with the use of these drugs. In Table 1 are listed the incidence of some of the more common toxic

*Renal calculi* are seen in patients receiving sulfapyridine and sulfathiazole and have been observed by us with sulfadiazine in only a single instance. Occasional cases of *anuria* have been seen with the use of sulfapyridine and sulfathiazole and have been reported with the use of sulfadiazine.<sup>7</sup> In such cases the drug should be stopped and fluids administered. Furthermore, it appears that the renal complications from these drugs, especially sulfapyridine and sulfathiazole, are due in part, if not entirely, to the presence in the urinary tract of crystals composed of these compounds. It has been our experience<sup>8</sup> that the incidence and number of these crystals may be decreased by administering equal amounts of alkali with sulfapyridine, sulfathiazole and possibly sulfadiazine.

*Crystalluria* occurs with the use of sulfadiazine, but is less apt to occur because of the slow rate of acetylation of this drug, and because acetylsulfadiazine is relatively more soluble in urine.

*Depression of the white blood cells* may occur at any time with these compounds. As far as we know, there have been no reports of *agranulocytosis* developing within the first twelve days of treatment with any of these drugs. In cases requiring chemotherapy for longer than ten days, the white blood count should be checked every few days. If the polymorphonuclear cells fall below 40 per cent it is best to stop treatment. *Acute hemolytic anemia* occurs in patients receiving sulfanilamide and sulfapyridine. It usually appears during the first four days of treatment and requires cessation of therapy. *Mild anemia* of the hemolytic type is frequently seen with sulfanilamide and sulfapyridine, but to a lesser degree with sulfathiazole and sulfadiazine and is not to be considered a serious complication. If the hemoglobin falls below 60 per cent, transfusions of citrated blood are indicated whether or not treatment is stopped. In this connection, it should be said that there is increasing evidence that the sulfonamides tend to alter the recipient's blood so that blood groupings become uncertain and the danger of transfusion reactions is increased.

*Hepatitis* and *peripheral neuritis* occur rarely with sulfanilamide, sulfapyridine and sulfathiazole therapy.

From the above remarks it is evident that the toxic effects



cent of cases. A careful check on fluid and salt balance is indicated in cases of severe vomiting.

*Fever* may occur with these drugs at any time, but is most commonly seen five to ten days after the beginning of treatment. Frequently it is followed by dermatitis, hemolytic anemia, or neutropenia and if drug fever occurs treatment should be stopped, unless the risk to the patient of continued infection seems to be greater than the risk of a severe drug reaction. At times it is difficult to determine whether the temperature rise represents a drug reaction or a recrudescence of the infection. Except in complicated conditions, the fever of the original infection is usually normal by the third day of treatment and if the patient is clinically improved one should suspect a secondary rise in temperature as being due to the drug. The leukocyte count may or may not be elevated during the course of drug fever. As a rule, if the fever is due to the drug it will drop within twenty-four to forty-eight hours if the drug is stopped and fluids are forced. If resumption of drug treatment is called for it is well to administer 5 grains by mouth and if no sharp febrile response occurs within twelve hours regular administration can be cautiously resumed.

*Drug rashes* may occur at any time after the beginning of treatment, especially after the fifth day. If the patient's condition warrants, the drug may be continued with caution, although it is best to stop treatment. *Conjunctivitis* is seen only in patients receiving sulfathiazole and occurs usually after the fourth day of treatment.

*Psychoses* due to these drugs occur at any time and if the infectious process is under control when it is observed the drug should be discontinued.

*Hematuria* is not observed with sulfanilamide, but occurs microscopically in patients treated with sulfapyridine, sulfathiazole and sulfadiazine. Gross hematuria occurs in sulfapyridine and sulfathiazole treated cases, but has not as yet been encountered by us with sulfadiazine, although it has been noted by others.<sup>7</sup> Unless a considerable number of red blood cells is detected, or evidence of ureteral blockage is apparent, cautious treatment may be continued, but it should be remembered that hematuria is often a precursor of severe renal insufficiency

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*Hepatitis* and *peripheral neuritis* occur rarely with sulfanilamide, sulfapyridine and sulfathiazole therapy.

From the above remarks it is evident that the toxic effects

associated with the use of these drugs are numerous, but most of them are not dangerous, and if the patients are closely watched while taking these drugs the more serious reactions may be minimized. The incidence of severe toxicity is increased with the *prolonged* administration of these compounds, but, fortunately, these drugs usually exert their maximum therapeutic effect within five days, so that treatment after that time is necessary only in complicated cases. Even though serious conditions may develop from the use of these drugs, there is no reason why a seriously ill patient should be denied the full benefit of chemotherapy simply because of the potential dangers associated with its use.

### CONTRAINDICATIONS

In our experience, the only contraindication to sulfonamide treatment is a history of a previous *sensitivity* to sulfanilamide and its derivatives as manifested by drug fever, gross hematuria, dermatitis, hemolytic anemia, neutropenia, or jaundice. Even in spite of such a known sensitivity, it might be advisable, if the infection is severe, to administer the drug and watch closely for toxic effects. In moderately severe infections a test dose of 5 grains of the drug may be given by mouth and the patient watched for twelve hours for possible toxic effects before beginning treatment. The presence of jaundice, nephritis, anemia, or leukopenia from some other cause does not contraindicate drug therapy. These conditions may disappear as the infection is brought under control by adequate sulfonamide therapy. We know of no medication or food which cannot be given to patients receiving the sulfonamides. In ambulatory cases it is best to advise against the use of alcohol, as at times it tends to produce marked dizziness.

### SELECTION OF DRUG

Clinical trial with these drugs in many kinds of infections has shown that certain bacteria are more sensitive than others to the various members of the sulfonamide group of compounds. It is important, therefore, that we know which member of this group of drugs is likely to give the best therapeutic results in a given infection. In order to be able to select the drug of choice it is of value, when possible, to make a bacterio-



chemotherapeutic agents it is likely that some of the recommendations regarding the selection of drugs will soon be subject to change. Already reports have appeared indicating that sulfadiazine may replace members of this group of drugs in the treatment of several diseases.<sup>7, 9, 10, 11, 12</sup> Regardless of the drug selected it is to be remembered that chemotherapy is not to be used to the exclusion or neglect of other therapeutic measures, such as specific serum, antitoxin, or surgery.

### METHODS OF ADMINISTRATION

In general, the *oral* administration of these drugs has proved to be the most satisfactory method in the treatment of acute infections. However, in certain instances where a rapid elevation of the blood level of the drug is desired, or where oral medication is impracticable or impossible, it is often necessary to resort to *parenteral* administration. Sulfanilamide, because of its relatively high degree of solubility in water, can be given subcutaneously or intravenously as a 1 per cent solution in sterile physiological saline. Best results with sulfanilamide parenterally are obtained with the subcutaneous route. In order to administer sulfapyridine, sulfathiazole, or sulfadiazine parenterally it is necessary, because of their physical properties, to employ the sodium salts of these drugs. For intravenous therapy with these compounds, a 5 per cent solution of the sodium salt in sterile distilled water is used.

### DOSAGE

Theoretically, all patients treated with the sulfonamides should have frequent estimations of the *concentration* of the drug in the blood. However, experience with these drugs, with the exception of sulfanilamide, has failed to show any correlation between therapeutic effectiveness and the blood level of free drug.<sup>6, 9, 13</sup> Moreover, certain factors, such as kidney function, drug absorption and the state of dehydration, all tend to influence the amount of drug found in the blood. Furthermore, in many instances in which these drugs are used, especially in military medicine, facilities for determining their concentration in blood will be lacking. Therefore, it seems reasonable for practical purposes to administer the approximate amount of

which experience indicates will probably be therapeutic-ly effective.

In discussing the dosage of these drugs, it is well to point out several factors which influence the *amount* of drug that is necessary to obtain the desired results. Patients treated in bed usually given larger amounts than those that are ambulatory. The type of infecting organism must be considered both as to its susceptibility to the drug and as to the severity and type of lesion which it produces. Acute conditions, involving soft tissues, require different dosages than do chronic bone infections. It becomes apparent, therefore, that it is impossible to outline a course of sulfonamide therapy which will suit the needs of every patient. However, once drug treatment has been started it is important to continue the drug until complete clinical cure is obtained. Not infrequently, a fall in temperature proves deceptive, and a spread or recurrence in the infection will occur if treatment is stopped too early. In general, the following recommendations on dosage are for the treatment of adult patients suffering with acute infections requiring full sulfonamide dosage.

**Sulfanilamide.**—A concentration of free sulfanilamide of 15 mg. per 100 cc. of blood will give maximum therapeutic effectiveness in most types of infections susceptible to the drug. Higher concentrations (15 mg. per 100 cc.) are indicated in certain instances such as meningeal infections. In general, adequate blood concentration of free drug can be accomplished by an initial dose of 3 to 5 gm. of sulfanilamide, followed by doses of 1 to 1.3 gm. every four hours day and night until the temperature has been normal for seventy-two hours, and definite clinical evidence of improvement exists. The dose may then be gradually reduced until the period of possible relapse has passed. The above dose schedule applies also to parenteral administration of sulfanilamide in 1 per cent solution by the subcutaneous route, although the rate of absorption by the tissues will influence the number of injections necessary. In general, it is necessary to give the drug every six to eight hours in order to maintain adequate blood levels of free drug.

**Sulfapyridine and Sulfathiazole.**—As mentioned above, the amount of free drug in the blood is of doubtful significance,

although a level of above 5 mg. per 100 cc. should give maximum results except in certain cases, such as meningitis, where higher levels (10 to 15 mg. per 100 cc.) are desirable. The usual dosage by mouth for these drugs is initially 3 to 4 gm. followed by 1 gm. every four hours day and night. For intravenous use the dosage of the sodium salts of these drugs is calculated on the basis of 0.06 gm. per kilogram of body weight and repeated at six-hour intervals.

**Sulfadiazine.**—Because of the behavior of sulfadiazine the average blood level of free drug is higher than that obtained with sulfapyridine or sulfathiazole and it is possible to administer this compound in 1-gm. doses at six-hour intervals instead of every four hours. The same initial dosage of 3 to 4 gm. is employed. Furthermore, the intravenous use of sodium sulfadiazine<sup>14</sup> is more easily controlled and it is possible to employ the same dosage as with sulfapyridine and sulfathiazole but at twelve-hour intervals.

**Sulfanilylguanidine.**—In addition to the drugs already discussed there is still another sulfonamide compound, sulfanilylguanidine, worthy of comment. Data concerning the preparation, structure, chemical and physical properties, pharmacology and experimental effectiveness have been presented in an excellent paper by Marshall and his associates.<sup>16</sup> This new drug differs from the other members of the sulfanilamide group in that it can be given by mouth in such doses that saturation of the intestinal contents occurs without producing levels of the drug in the blood higher than 4 mg. per 100 cc.

Because of the antibacterial activity of sulfanilylguanidine, it was suggested that this drug or some other derivative having similar properties might be useful in the treatment of infections mainly or entirely localized in the lumen of the intestine. Already several papers<sup>16, 17</sup> have appeared indicating its therapeutic effectiveness in bacillary dysentery (Table 2). According to these reports the drug gives rise to comparatively few toxic effects, although drug rash, drug fever, conjunctivitis and crystalluria have been observed. The following dosage has been suggested for adults:<sup>10</sup> initial dose, by mouth, 0.1 gm. per kilogram of body weight followed by 0.05 gm. per kilogram every four hours until the number of stools per day is

five or less, then 0.05 gm. per kilogram every eight hours for seventy-two hours. Since practically all of the absorbed drug is excreted by the kidneys, the importance of maintaining an adequate urinary output is advisable, as with the other sulfonamides. It is likely that sulfanilylguanidine will prove to be effective in other intestinal infections, although its use in typhoid fever, paratyphoid fever and ulcerative colitis has been disappointing in our experience.

The cardinal principles of sulfonamide therapy are summarized in Table 3.

TABLE 3

## CARDINAL PRINCIPLES OF SULFONAMIDE THERAPY

1. Inquire as to previous sulfonamide toxicity.
2. Make proper selection of drug.
3. Start chemotherapy early in disease.
4. Administer large initial dosage of drug.
5. Administer drug by schedule day and night.
6. Maintain urinary output of 1200 cc. every 24 hours.
7. Watch patient closely for possible drug reactions.
8. Continue chemotherapy until complete cure is obtained.
9. Employ other therapeutic measures when indicated.
10. Employ early surgical drainage of localized suppurative lesions.

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## MANAGEMENT OF SHOCK AND TREATMENT OF BURNS\*

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Any comparison of the therapy of shock and burns must, of necessity, consider the *extent* and *degree* of the lesion, the *age* and *physical status* of the patient as well as the therapeutic measures undertaken. It is common knowledge that

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minimal lesions will, in the physically debilitated, produce serious systemic reactions, and the corollary is equally true.

For all these reasons we will consider in this brief discussion only those essential elements of therapy and general management which are likely to be effective in the majority of cases.

### SHOCK

**Physiology.**—The exact mechanism of the production of shock and the existence of a hypothetical toxic substance is still the subject of much investigative work. As initiating factors we must consider external and/or internal bleeding at the site of injury, loss of plasma in the traumatized tissue, loss of plasma followed by hemoconcentration in burns and in trauma to the intestine, infection, dehydration, asphyxia, cold, fear, pain—in brief, all stimuli leading to hyperactivity of the sympathetic nervous system, vasoconstriction with consequent asphyxia of the peripheral tissues, and increased permeability of the capillaries with leakage of blood plasma and consequent loss of blood volume.

It is this progressive loss of circulating blood volume that constitutes the essential lesion in shock, and consequently all efforts must be pointed toward its immediate and permanent relief, if we are to be successful in our therapeutic efforts.

**Prophylaxis.**—All that is possible must be done to remove the causes of shock, since prophylaxis is far more successful than treatment. Patients exposed to obvious and sufficient precipitating factors must be treated as potential cases of shock, without waiting for the appearance of clinical symptoms. Obviously, cases of shock with minimal manifestations must be treated immediately and adequately, since the management of early shock is as a rule a simple and successful procedure, whereas the profound shock which is likely to follow is often very difficult to combat.

**Treatment.**—1. *A sedative suitable to the condition of the patient is administered*, the primary consideration being the relief of pain.

2. *The patient is kept warm*, by any suitable method.

3. *Venoclysis should be instituted immediately*. Great difficulty is often experienced in late and severe shock in getting a

needle into the patient's vein. Therefore, venoclysis should be done *at once*, and the administration of 5 per cent glucose in saline solution begun to keep the needle open while a suitable infusion material is made ready, as pointed out later. A simple, sterilized surgical kit for exposing a vein must be regarded as indispensable in all places where shock is likely to require treatment. This should consist of necessary ligatures, scalpel, dissecting scissors and forceps, and a hemostat, in addition to a suitable antiseptic preparation, dressing material, and a 0.5 per cent procaine solution, syringe and needle for local anesthesia.

4. *Surgical care* of patients in shock must be guided with primary reference to the state of shock. This involves immediate immobilization of fractures, the proper choice of an anesthetic agent, the control of hemorrhage, elevation of the foot of the bed, oxygen administration and a score of other procedures which space does not permit mentioning here.

5. The most essential factor in the treatment of shock is the *re-establishment of an adequate volume of circulating blood*, with resultant increase of the blood pressure, and relief of clinical symptoms. The ideal fluid for this purpose has been found to be isotonic citrated human plasma. The reasons for this choice are briefly summarized in the paragraphs which follow.

**METHODS OF RE-ESTABLISHING BLOOD VOLUME.**—Electrolyte solutions are not long retained within the vascular system and add only momentarily to the blood volume. Thus only acacia solution, hemoglobin solution, blood, serum and plasma require consideration.

*Acacia.*—Acacia has been used in the treatment of shock and the nephrotic syndrome, and there is evidence that it increases the osmotic pressure of the blood. However, it is stored for long periods of time in the liver, where it produces deleterious effects.

*Hemoglobin.*—Intravenous administration of hemoglobin (5 per cent solution) is still in the experimental stage. The evidence so far gathered indicates that, because of the small size of the molecule and the rapidity with which it is disposed



of by the reticulo-endothelial system, its effect would at best be of relatively short duration.

*Human Albumin.*—More promising, but still in the experimental stage, is the use of purified human albumin (Cohn).

*Blood.*—Blood is generally a good agent, but it has the following *disadvantages*: (1) It adds to hemoconcentration, if already present. (2) It requires time-consuming and exacting preliminary steps (typing, cross-matching). (3) It has a limited period of preservation, and transportation is made difficult and cumbersome by strict refrigeration requirements.

*Advantages of Plasma Over Serum.*—Of plasma and serum much can be and has been said. While recognizing the similarity in action of these two blood substitutes, we prefer plasma over serum for the following reasons: (1) It is easily obtained, and is often a by-product of the blood bank. (2) It gives a greater yield of the fluid phase. (3) Extensive clinical experience in the hands of many investigators has shown the absolute freedom of reaction following its administration, when it has been properly prepared and preserved. (4) It contains more of the essential elements of whole blood.

*Isotonic Plasma: Dosage and Technic of Administration.*—The intravenous administration of plasma in shock must be instituted as soon as the material is available. We have already mentioned that, in order to save time, the venoclysis with 5 per cent glucose in saline solution should be instituted at once, and that plasma should be substituted as soon as possible. The ideal method of administration is by the continuous drip technic, the rate of administration to be determined entirely by the patient's condition.

In cases of very severe shock, it is desirable to administer the first 250 cc., occasionally the first 500 cc., within a few minutes. It is necessary in these cases to apply pressure, which can be most conveniently done by forcing air through the air filter valve of the receptacle containing the fluid. This is readily done with the apparatus described elsewhere.<sup>1</sup> In mild cases a rate of administration of from 10 to 20 cc. per minute, requiring fifteen to thirty minutes for a dose of 300 cc., is sufficient.

The total requirement of plasma depends naturally on a

multiplicity of factors, in which the severity of shock, the patient's weight, his physical state prior to injury, and hydration play essential roles. In mild shock 17.5 to 35 gm. of plasma proteins are usually sufficient (250 to 500 cc. of undiluted plasma); most severe cases require from 35 to 70 gm. of plasma proteins for relief (500 to 1000 cc. of undiluted plasma). In extremely severe cases, especially when abnormal intestinal permeability is present, even greater doses may be required for satisfactory results. The best guides to the therapy are (1) the blood pressure, (2) the pulse rate and (3) the patient's clinical condition.

Once more at this point we must emphasize that early treatment of shock may be carried out with minimal doses of plasma, and that the patients requiring maximal doses are not necessarily the patients most severely injured, but those who *did not* receive adequate early care.

*Hypertonic Plasma.*—The routine use of hypertonic plasma in the treatment of shock is not supported by facts. In cases of injury, particularly those injuries incurred during widespread emergencies, such as war, *dehydration* is likely to play a major role, therefore rapid administration of water by vein is essential. This does not deny that, in a normally hydrated patient, the administration of hypertonic plasma produces results similar, but not as uniform, as those obtained by isotonic plasma, in respect to the dilution time. Whole blood transfusion may be given later, if necessary.

#### BURNS

The care of the mild to moderate lesion, with little or no systemic reaction, consists in the application of any one of numerous anesthetic and antiseptic ointments. It must be kept in mind, however, that shock may occur in comparatively slight burns. It is the moderate to severe lesion, with varying degrees of burned area, usually associated with severe shock, which we are to consider in more detail.

*Routine Treatment of Severe Burns.*—It has been the practice at the Bryn Mawr Hospital during the past few years, in most cases of severe burns, to carry out as the circumstances allow the following routine:

1. Sedatives, usually morphine sulfate, are used, when

indicated, in sufficient amount to produce a full therapeutic effect.

2. The patient is kept warm by means of blankets, hot water bottles, heat cradles, and the like. All possibilities of exposure are kept to a minimum.

3. As quickly as the necessary physical examination can be completed, a venipuncture is made for the collection of a specimen of blood. The needle remains in place and the intravenous administration of 5 per cent glucose in distilled water by the drip technic is begun.

4. Hematologic and chemical studies are carried out immediately on the collected blood specimen.

5. As soon as possible thereafter, without anesthesia, or when necessary under anesthesia produced by avertin instilled rectally, the burned areas are cleansed with tincture of green soap and ether. Tanning by the alternate use of 10 per cent tannic acid and 10 per cent silver nitrate spray is begun. Areas such as the face and hands might better be treated with 5 per cent sulfathiazole ointment to avoid gross scarring and deformity, as recently suggested, provided experience shows that no untoward reactions result.

6. Tetanus antitoxin is administered, when indicated.

7. The family and friends of the patient are solicited to act as blood donors.

**Management of Shock.**—The principal problem in the early stages is of course, the one of "shock" and the readjustment of the profoundly altered blood chemistry and fluid balance. Determinations of the hemoglobin content, the number of red cells, the hematocrit reading and the total serum protein content by the specific gravity method are made every four hours, if possible. Immediately following the burn, frequently all the formed elements of the blood are increased—the patient is dehydrated in the sense that the fluid is no longer in the vascular bed but in the tissues—and the hemoconcentration with increased viscosity, decreased circulation, and so on, results in further peripheral anoxia and further damage to the capillary endothelium. At this point fluids are required. At the same time, or shortly thereafter, it is noted that, although the

formed elements of the blood are usually still concentrated, hypoproteinemia has developed.

*Plasma.*—It is now that plasma is particularly indicated. The following clinical case illustrates this point:

E. G., a white woman aged thirty-five years, was admitted to the Bryn Mawr Hospital at 11:45 A.M., January 19, 1939, suffering from second and third degree burns of both legs, thighs and buttocks, arms and hands, the result of ignition of a negligee made of inflammable synthetic silk. Determinations made two and one-half hours after the accident showed a severe hemoconcentration not accompanied by hypoproteinemia, but by an alteration of the albumin-globulin ratio as shown by the following figures: hemoglobin, 19.5 gm. per 100 cc. of blood; red blood cells, 6,700,000 per cu. mm.; white blood cells, 15,500 per cu. mm.; total proteins, 7.9 gm. per 100 cc. of serum (albumin, 3.8 gm., globulin, 4.1 gm.). By 9 A.M. of January 20, or nearly twenty-four hours after the burns, the patient had received 3250 cc. of 5 per cent glucose in saline, 3250 cc. of 5 per cent glucose in water as well as 650 cc. of blood plasma, or a total of 7150 cc. of fluids. At this time the hemoglobin was 19.2 gm. per 100 cc., the red blood cells 6,640,000 per cu. mm., and the total serum proteins 6.9 gm. per 100 cc. On January 21, forty-eight hours after the burns, the total serum proteins were 6.2 gm. per 100 cc. despite the additional administration of 300 cc. of plasma.

Plasma may be fresh or stored in the frozen or dried state. There is no need for the use of hypertonic material.

Great quantities of plasma are necessary in the treatment of the severely burned. It is for this reason that, immediately after the patient's admittance, the family and all the possible friends thereof are asked to act as blood donors to replace the material which has already been given the patient and to build up a sizable reserve. When four severely burned patients were recently admitted to the hospital at 7 A.M., we had collected 120 lots of blood (approximately 500 cc. each) by 10 P.M. of the same day from various friends of the family, which insured the patients of adequate material. In war and widespread civilian emergencies involving burns, very large stores of plasma preserved in the frozen or in the dry state are essential.

*Complicating Factors; Nutrition.*—Subsequently, the questions of *injection*, *toxemia* and *nutrition* become important. If the area beneath the eschar becomes fluctuant, it may not be the result of infection but rather of edema or some other factor. If there is any question, a culture will decide the point.

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2. The patient is kept warm by means of blankets, hot water bottles, heat cradles, and the like. All possibilities of exposure are kept to a minimum.

3. As quickly as the necessary physical examination can be completed, a venipuncture is made for the collection of a specimen of blood. The needle remains in place and the intravenous administration of 5 per cent glucose in distilled water by the drip technic is begun.

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5. As soon as possible thereafter, without anesthesia, or when necessary under anesthesia produced by avertin instilled rectally, the burned areas are cleansed with tincture of green soap and ether. Tanning by the alternate use of 10 per cent tannic acid and 10 per cent silver nitrate spray is begun. Areas such as the face and hands might better be treated with 5 per cent sulfathiazole ointment to avoid gross scarring and deformity, as recently suggested, provided experience shows that no untoward reactions result.

6. Tetanus antitoxin is administered, when indicated.

7. The family and friends of the patient are solicited to act as blood donors.

**Management of Shock.**—The principal problem in the early stages is of course, the one of "shock" and the readjustment of the profoundly altered blood chemistry and fluid balance. Determinations of the hemoglobin content, the number of red cells, the hematocrit reading and the total serum protein content by the specific gravity method are made every four hours, if possible. Immediately following the burn, frequently all the formed elements of the blood are increased—the patient is dehydrated in the sense that the fluid is no longer in the vascular bed but in the tissues—and the hemoconcentration with increased viscosity, decreased circulation, and so on, results in further peripheral anoxia and further damage to the capillary endothelium. At this point fluids are required. At the same time, or shortly thereafter, it is noted that, although the

formed elements of the blood are usually still concentrated, hypoproteinemia has developed.

*Plasma.*—It is now that plasma is particularly indicated. The following clinical case illustrates this point:

E. G., a white woman aged thirty-five years, was admitted to the Bryn Mawr Hospital at 11:45 A.M., January 19, 1939, suffering from second and third degree burns of both legs, thighs and buttocks, arms and hands, the result of ignition of a negligee made of inflammable synthetic silk. Determinations made two and one-half hours after the accident showed a severe hemoconcentration not accompanied by hypoproteinemia, but by an alteration of the albumin-globulin ratio as shown by the following figures: hemoglobin, 19.5 gm. per 100 cc. of blood; red blood cells, 6,700,000 per cu. mm.; white blood cells, 15,500 per cu. mm.; total proteins, 7.9 gm. per 100 cc. of serum (albumin, 3.8 gm., globulin, 4.1 gm.). By 9 A.M. of January 20, or nearly twenty-four hours after the burns, the patient had received 3250 cc. of 5 per cent glucose in saline, 3250 cc. of 5 per cent glucose in water as well as 650 cc. of blood plasma, or a total of 7150 cc. of fluids. At this time the hemoglobin was 19.2 gm. per 100 cc., the red blood cells 6,640,000 per cu. mm., and the total serum proteins 6.9 gm. per 100 cc. On January 21, forty-eight hours after the burns, the total serum proteins were 6.2 gm. per 100 cc. despite the additional administration of 300 cc. of plasma.

Plasma may be fresh or stored in the frozen or dried state. There is no need for the use of hypertonic material.

Great quantities of plasma are necessary in the treatment of the severely burned. It is for this reason that, immediately after the patient's admittance, the family and all the possible friends thereof are asked to act as blood donors to replace the material which has already been given the patient and to build up a sizable reserve. When four severely burned patients were recently admitted to the hospital at 7 A.M., we had collected 120 lots of blood (approximately 500 cc. each) by 10 P.M. of the same day from various friends of the family, which insured the patients of adequate material. In war and widespread civilian emergencies involving burns, very large stores of plasma preserved in the frozen or in the dry state are essential.

*Complicating Factors; Nutrition.*—Subsequently, the questions of *infection*, *toxemia* and *nutrition* become important. If the area beneath the eschar becomes fluctuant, it may not be the result of infection but rather of edema or some other factor. If there is any question, a culture will decide the point.



indicated, in sufficient amount to produce a full therapeutic effect.

2. The patient is kept warm by means of blankets, hot water bottles, heat cradles, and the like. All possibilities of exposure are kept to a minimum.

3. As quickly as the necessary physical examination can be completed, a venipuncture is made for the collection of a specimen of blood. The needle remains in place and the intravenous administration of 5 per cent glucose in distilled water by the drip technic is begun.

4. Hematologic and chemical studies are carried out immediately on the collected blood specimen.

5. As soon as possible thereafter, without anesthesia, or when necessary under anesthesia produced by avertin instilled rectally, the burned areas are cleansed with tincture of green soap and ether. Tanning by the alternate use of 10 per cent tannic acid and 10 per cent silver nitrate spray is begun. Areas such as the face and hands might better be treated with 5 per cent sulfathiazole ointment to avoid gross scarring and deformity, as recently suggested, provided experience shows that no untoward reactions result.

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*Complicating Factors; Nutrition.*—Subsequently, the questions of *infection*, *toxemia* and *nutrition* become important. If the area beneath the eschar becomes fluctuant, it may not be the result of infection but rather of edema or some other factor. If there is any question, a culture will decide the point.

If infection is present, the eschar should be removed from the infected area and some ointment, such as cod liver oil ointment, applied. Frequent blood cultures have diagnostic importance.

The anoxia, long sustained, together with the toxemia, produces marked damage and dysfunction of numerous vital organs. Marked anemia develops, elevation of the serum bilirubin is frequent, hypo-albuminemia persists. High caloric, high polyvitamin diets are indicated, as well as plasma and whole blood transfusions from a nutritional point of view.

The administration of *eschatin* (adrenal cortical hormone) in the treatment of the early phase of shock and to protect the capillary endothelium has been suggested and according to some appears beneficial.

The problem of *edema* is a serious one. Its pathogenesis is attributable largely to hypoproteinemia, although undoubtedly in some cases prolonged hydration with glucose-saline solution and renal damage are partly responsible.

Our main efforts must be directed toward the maintenance of a proper protein and electrolyte balance, with a proper intake and output of fluid.

**Illustrative Cases.**—A few cases to illustrate our experience follow. In all these cases, the plasma figures represent cubic centimeters of undiluted plasma, 100 cc. containing 7.1 gm. of plasma proteins.

**CASE I.**—M. W., a seventeen-year-old white girl, was brought to the hospital at 2 A.M., March 2, 1940, after her clothing had caught fire at a dance. She had first and second degree burns of the face, neck, entire thorax, and both arms and hands. It was estimated that 60 per cent of her body surface had been burned. Her blood pressure was 100 systolic, 70 diastolic, and the pulse rate was 116, the pulse being weak and thready. She was given immediate treatment for shock, consisting of elevation of the foot of the bed, hot water bottles to the feet, and warm blankets. Morphine sulfate,  $\frac{1}{4}$  grain, was given for pain and repeated as necessary. An intravenous infusion of 5 per cent glucose in saline was started and plasma was substituted within a half hour of admission. The burned areas were débrided of charred skin and clothing and cleansed with green soap and ether. These areas, except the face, were sprayed with 10 per cent tannic acid and 10 per cent silver nitrate alternately, until a tan was obtained. The cheeks and chin were covered with tannic acid ointment, and cod liver oil ointment was applied around the eyes. Blood counts and determinations of hemoglobin and plasma protein were made frequently and fluids were administered as seen in Fig. 229.

On the fourth day the patient developed edema of the face and extremi-

ties. This decreased as the plasma level was increased with larger amounts of blood plasma.

On the eleventh day the patient's temperature was 105° F. A collection of purulent serum was found under some of the eschar. The eschar, wherever it was found, was débrided and the temperature returned to normal by lysis. Cod liver oil dressings were applied to the areas from which the eschar was removed. There was complete epithelization without contracture or scarring,

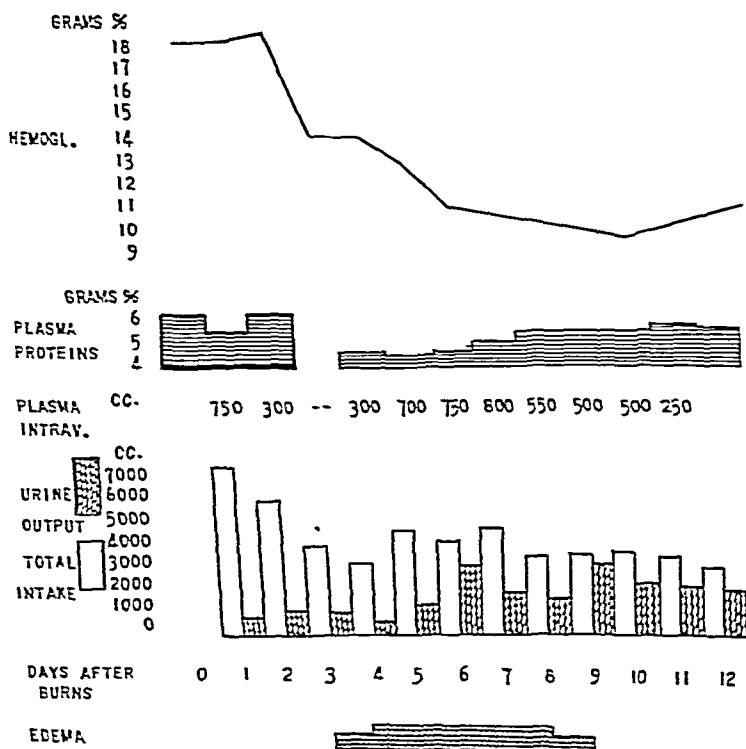


Fig. 229.—Therapeutic course in Case I (first, second and third degree burns of 60 per cent of body surface.)

except for a small area on the right elbow. To this area pinch grafts taken from the right thigh were applied one month after admission.

It is to be noted that this patient never received whole blood, that the total amount of plasma received in eleven days was 5400 cc., or about 383 gm. of plasma proteins.

**CASE II.**—S. D., a twenty-seven-year-old white woman, was brought to the hospital on January 15, 1940, suffering from second and third degree burns of the right hand and third degree burns of the legs and dorsa of the feet. She

TABLE 1  
SUMMARY OF THERAPEUTIC COURSE IN CASE II (SECOND AND THIRD DEGREE BURNS OF RIGHT HAND, LEGS AND DORSA OF FEET)

Date:	15			16	17	18	19	20	21	22	23	24	25	26	27	28	29
	9 A.M.	2 P.M.	5 P.M.	9 P.M.													
Hemoglobin, grams per 100 cc. . .	16 9	18 6	14 8	14	19 8	16 4	12 5	14 2									10.9
Red blood cells, millions. . .	5 0	5 4	4 6		5.8	4 6	3.8	4 1									3.3
																	550
Plasma chlorides. .				560		530	530	540	560		530						57
Carbon dioxide, volumes per cent .						48	46	47			61						6.94
Total plasma proteins. .		6 6	5 8			4 9	5 01	5 28	5.84		5 87						—
Edema . .					—	*	—	—	—	—	—	—	—	—	—	—	—
Fluids, intake and output:										250							
Plasma						500	500	250	250								
5% glucose in saline solution.							250	250									
5% glucose						3700	2000	2000	1000	1000							
Fluids by mouth						600	1200	3570	3 190	2640	2850	2940	2610				
Total intake . .						1800	6200	6320	4950	2610	2850	2910	2640				
Total output							1250	3500	2900	805	775	1175	775	1275			

\* Slight edema of left hand

was given immediate treatment for shock and an infusion of 5 per cent glucose in saline was started, followed by plasma within twenty minutes. After sedation with morphine sulfate, the burned areas were débrided of charred skin and clothing and cleansed with green soap and ether. The areas were then sprayed with 10 per cent tannic acid and 10 per cent silver nitrate alternately until tanned. Determinations of the blood hemoglobin and plasma proteins were made frequently and fluids administered as seen in Table 1. The eschar was removed on the tenth to the thirteenth days and then cod liver oil dressings were applied daily to the granulating surface. Pinch grafts were applied to the legs on March 11 and on April 22. The patient was discharged on May 14.

**CASE III.**—B. M., a thirty-two-year-old white man, was brought to the hospital after having received second and third degree burns of the face, neck, hands and legs from gasoline fire. The patient was in a condition of shock on admission, and he was immediately treated with heat, elevation of the foot of the bed, sedation with morphine sulfate, and 5 per cent glucose and saline intravenously, followed shortly by 500 cc. of plasma. The burned skin and clothing were removed and the areas sprayed with 10 per cent silver nitrate and 10 per cent tannic acid. Cod liver oil ointment was applied to the face and albolene to the conjunctiva. Fluids were administered as indicated by the results of hemoglobin, erythrocyte and plasma protein determinations (Table 2).

On the fifth day, the eschar became loose and it was gradually removed with underlying necrotic fat, fascia and large areas of muscle and bone. Continuous dressings of warm saline were applied to these areas. The temperature rose gradually until the fifteenth day when it reached 105° F., when death occurred suddenly.

The autopsy revealed extensive burns involving over one half of the body surface, of such degree as to produce loss of muscle and bone. Death was attributed to a combination of severe gastric hemorrhage, atelectasis of the lungs with focal pneumonitis, and fibrocaseous tuberculosis with recent extensive spread. Remarkable were the relative freedom from edema and the absence of degenerative changes of the liver, suprarenal glands and kidneys. The absence of edema is to be considered in relation to the high plasma protein losses, to the high daily water intake, averaging 5550 cc. for fourteen consecutive days, and the adequate urinary output, averaging 2123 cc. daily. In fourteen days this patient received 7350 cc. of undiluted plasma, containing approximately 522 gm. of plasma proteins.

**CASE IV.**—F. C., a twenty-seven-year-old white woman, was brought to the hospital on January 15, 1940, at 6:50 A.M. suffering from second and third degree burns of the face, neck, both forearms and hands, and both legs, from just above the knees downward including the dorsa of the feet. It was estimated that a third of the body surface was burned. She was immediately given prophylactic treatment for shock and an infusion of 5 per cent glucose in saline was begun. Morphine sulfate,  $1\frac{1}{4}$  grain, was given for pain and repeated as necessary. The burned areas were débrided of charred skin and clothing and cleansed with green soap and ether. These areas, except for the face, were sprayed with 10 per cent tannic acid and 10 per cent silver nitrate alternately. The face was covered with cod liver oil ointment and the inflamed conjunctiva was treated with albolene and irrigations with boric acid solution. Frequent determinations of the hemoglobin, erythrocytes and plasma proteins were made and fluids were administered as seen in Table 3. The patient received nearly continuous intravenous therapy for the first five days.

TABLE 2

SUMMARY OF THERAPEUTIC COURSE IN CASE III (SECOND AND THIRD DEGREE BURNS OF FACE, NECK, HANDS AND LEGS [ONE HALF BODY SURFACE])

Date:	January	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Hemoglobin, grams per 100 cc..	18 6	18 6	16 9	12 9											13
Red blood cells, millions	5 99	5 4	5 0	3 8	4 1										4.2
Plasma chlorides.	630	540	550	560	510	540			480	570				570	
Carbon dioxide, volumes per cent		43	43	42					63	64			67	57	
Total plasma proteins	5 6	5 4	4 94	4 59		4 8			5 35	5 4			4.11	4 94	
Edema	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fluids, intake and output:															
Plasma	1000	600	500	750	500	500	500	250	250	250	250	500	1000	250	750
5% glucose in saline solution	6000	7000	4150	2850	500				2500	2000	250	2000	3000	2800	1000
5% glucose	300	2200	1500	2000	4500	4750	6000	6000	800		1000	1000	3000	2000	1500
Fluids by mouth	—	—	—	—	870	720	630	630	1200	3270	3630	2970	570	510	570
Total intake	7300	9800	6150	5600	6370	5970	6880	6880	4750	5520	5130	6470	7570	5560	3520
Total output	1850	2720	1850	1870	2325	3450	4125	4125	2425	1400	1700	2000	2050	2500	2550

TABLE 3  
SUMMARY OF THERAPEUTIC COURSE IN CASE IV (SECOND AND THIRD DEGREE BURNS OF FACE, NECK, FOREARMS AND LEGS [ONE THIRD OF BODY SURFACE])

Date:	January	15	16	17	18	19	20	21	22	23	24	25
Hemoglobin, grams per 100 cc.....	12.7	16.4	16.4	16.4	13.9	14.03						
Red blood cells, millions.....	4.1	4.9	4.8	4.7	4.1	4.1						
Plasma chlorides.....		500		570	530	530	530	530				
Carbon dioxide, volumes per cent.....		67		51	60	60						
Total plasma proteins.....	5.6	4.8	5.0	4.97	5.49	5.49	5.9	6.6				
Edemat.....	—	—	—	—	—	—	—	—	—	—	—	—
Fluids, intake and output:												
Plasma.....	800	700	500	250	250	250						
5% glucose in saline solution.....	6000		2500	900	250	250						
5% glucose.....		3000	3000	2000	2000	1000						
Fluids by mouth.....		500	450	3960	3390	3390	2610	2880	3300	2240	2882	2760
Total intake.....	6890	4200	6950	7110	4890	4890	2610	2880	3300	2240	2882	2760
Total output.....	2200	1175	1650	2600	2600	2850	900	1000	1200	1375	760	1225



After ten days the eschar was gradually removed. There was no growth of epithelium on the legs, and grafts were applied to them at weekly intervals after the first month. On May 2, three and one-half months after admittance, the patient had a sudden pain in her chest, with marked shortness of breath, and died within an hour. As all the veins of her arms were thrombosed, death was thought to have been due to pulmonary embolism.

### COMMENT

Although clinical investigations will undoubtedly contribute in the future new means of treating shock and burns, the main problem will likely remain the rapid and permanent re-establishment of a proper circulating volume of blood and of the chemical balance of the body fluids.

In our opinion the intravenous administration of citrated blood plasma is the preferable and essential therapeutic means. This suggests the necessity of close cooperation between the *clinician* and the *pathologist* for the (1) proper studies, such as hemoglobin determination, erythrocyte count, total plasma protein determination, hematocrit reading and blood chloride determinations, to determine the course of therapy, and (2) a proper set-up for obtaining an adequate number of blood donors, and proper apparatus and technical help for obtaining the blood and the preparation and preservation of plasma.

This type of teamwork must be applied alike to the ordinary needs of hospitals, as well as to emergencies involving a large number of casualties, both among the civilian population and among troops, remembering that it is usually difficult, if not impossible, to obtain within a short period of time the large quantity of material necessary for treatment of even a moderate number of casualties.

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## THE TREATMENT OF MINOR WAR INJURIES

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THE wounded in war may be roughly divided into those cases which require transportation on a stretcher and those wounded soldiers who are able to stand, sit or walk, the "walking wounded." This classification arises from the fact that military surgery, as opposed to civilian surgery, must concern itself with the early transportation of the injured, and those who can stand, sit or walk can be most easily moved away from the battle area to general hospitals. More of these patients can occupy an ambulance or railroad car, and also such patients can usually be brought with greater rapidity to the place where their injuries are first treated than the wounded who must be borne on a stretcher.

### DEFINITION

It is proposed in the present discussion arbitrarily to define minor war injuries as those casualties which do not require transportation by stretcher, *i.e.*, the "walking wounded." They comprise burns that do not produce shock or serious disability, flesh wounds of the upper extremities and minor flesh wounds of the head, neck, trunk and lower extremities. Compound fractures of the upper extremity are included, as patients with such injuries frequently are able to sit or stand after débridement of the wound and immobilization of the part in plaster of Paris.

## ORGANIZATION

It would be meaningless to discuss the treatment of war injuries without at least a very brief mention of the facilities for applying the treatment proposed. Warfare in the past five years has reverted again to one of movement, as opposed to the more or less fixed trench warfare of 1914-1918. The development of the airplane has eliminated safe areas, twenty or thirty miles back of the fighting line. In modern total war, high explosive bombs can wreck hospitals well to the rear of the fighting area. The war of movement and of the airplane, consequently, has resulted in inevitable and necessary changes in the handling of wounded soldiers.

**The Surgical Team of the Spanish War.**—In the Spanish Civil War, 1937 to 1939, the medical organization of the Loyalists for the care of the wounded underwent considerable modification during the course of the war. The basis of the Spanish Republican medical organization was a "surgical team," which was self-sufficient and equipped with its own means of transportation.<sup>11</sup> The "team" consisted of fourteen people; two surgeons and two anesthetists and the appropriate number of nurses, orderlies, etc. Transportation was provided by an "autochir," a large truck which carried the operating room equipment, autoclave, generator for electric current, and other accessories. In addition, there was an ambulance for the transportation of the personnel. When the team was established for work the ambulance was used to evacuate the wounded. This group could go to a forward position close to the front line, and be ready to take care of wounded in a few hours. Several of these groups could be combined to form, with other personnel, general or evacuation hospitals. The division of the medical organization into such teams made for efficiency because the individuals were accustomed to working together. In a special article in the *Lancet*<sup>15</sup> the advantages of this system are mentioned and the elimination of unnecessary advanced dressing stations is recommended.

**Evacuation of the Wounded.**—Rapid evacuation of the wounded from the scene of the fighting is of the utmost importance. All unnecessary halts before reaching the place where first definitive surgical treatment is undertaken should be

eliminated.<sup>14</sup> Transportation of the wounded by airplane is probably only of value under special circumstances, *i.e.*, where the enemy has either lost control of the air or is rapidly retreating. Such circumstances obtained during the German operations in Poland and have been described by Schmidt.<sup>26</sup> Jolly<sup>11</sup> emphasizes that the care of the wounded should be based upon the time factor, rather than the distance from the scene of the fighting, the object always being to render adequate surgical care at the earliest possible moment.

The efficiency and adaptability of these basic surgical teams provided with their own means of transportation were admirably shown under the test of war conditions in Spain.

### BURNS

Because of the great number of gasoline-propelled vehicles in modern warfare, and the increasing use of incendiary bombs, it is likely that there will be an increasing incidence of burned patients. The systemic treatment of extensive burns does not lie within the province of this paper. We shall consider only the local treatment of burns of such extent that they do not produce shock.

The greatest change from civilian practice has been the elimination of *tannic acid* in the treatment of burns of the *hands and face*.<sup>16, 25, 29</sup> The tendency of the stiff eschar to crack over areas frequently moved, as the fingers and face, opens up avenues for infection. Furthermore the tan may interfere with the blood supply of the fingers and produce necrosis of the distal phalanges (Figs. 230 and 231).

**Minor Burns.**—The War Wounds Committee of the Medical Research Council in England has published an outline of the treatment of minor burns,<sup>16</sup> which is an excellent summary of current methods. It advises cleansing minor burns with *soap, water and ether*. Thorough cleansing and *débridement* are essential. The mechanical element in cleansing is important but must be done with a minimum of trauma. The skin surrounding the burned area should also be cleansed carefully, adjacent hair shaved for some distance from the margin of the burn and meticulous care taken to remove overhanging bits of devitalized tissue along the edge of the burn. Special attention

should be given to nails as these serve as potent sources for subsequent infection.<sup>4</sup>

Following the soap and water toilet and the débridement the area is thoroughly washed with saline solution and dried. *Sterile vaselinized gauze* is then applied to burns of the face and hands. *Tannic acid jelly* or 1 per cent *gentian violet jelly* is used for burns on other parts of the body. When these jellies are used, no dressing is applied.



Fig 230—Third degree burn of hand treated with tannic acid Terminal necrosis of the fingers can be seen (Wakely, "The Treatment of War Burns," Surgery, Vol 10, p 207, 1941)

**Severe Burns.**—More extensive burns are similarly cleansed and then dusted with *sulfanilamide* powder. Except in burns of the face, hands, wrists, or feet, some *coagulant* is then applied. Those commonly used are (1) 10 per cent silver nitrate, (2) 10 per cent tannic acid, (3) 10 per cent silver nitrate and 5 per cent tannic acid, used alternately, (4) "triple dye" (gentian violet, 1:400, brilliant green, 1:400, and neutral

acriflavine, 1:1000, equal parts of each). The coagulants are best applied with a gauze mop. Great care should be exercised if circumferential tanning is used, for fear of interfering with the blood supply. On those parts where coagulants cannot be used the burns are cleansed, dusted with sulfanilamide powder



Fig. 231.—Skiagram of hand depicted in Fig. 230, showing necrosis of the terminal phalanges. (Wakely, "The Treatment of War Burns," Surgery, Vol. 10, p. 207, 1941.)

and covered with *tulle gras*, which is in turn covered with six or eight layers of gauze soaked in salt solution. Tulle gras consists of squares of curtain net (mesh 2 mm.) impregnated with soft paraffin, 96 gm., and balsam of Peru, 2 gm., and then autoclaved. When treating extensive burned areas with sulfanilamide powder, the total amount used should not exceed 20



or 30 gm., in order not to produce excessive concentrations of the drug in the blood.<sup>9</sup>

*Morphine* should always be used liberally in severely burned patients, and *antitetanic serum* administered prophylactically. If infection occurs beneath the tan, the tan must be soaked off with salt solution and treatment continued by saline baths and dressings.

The recent development by Bunyan<sup>2</sup> of waterproof envelopes which entirely enclose a limb and which are filled at intervals with electrolytic *sodium hypochlorite* for irrigation, may be of value in the later treatment of some burns after evacuation of the patient from the front line area. The method is better adapted for use in hospitals<sup>7</sup> than in advanced stations for the treatment of wounded.

#### FLESH WOUNDS

The operative treatment of flesh wounds remains the same as in the first World War, with the addition of the use of chemotherapy. We shall only consider here flesh wounds of the upper extremity and nonpenetrating wounds of the head and trunk.

**Débridement.**—With the exception of small through-and-through bullet wounds which require no special care, the treatment is débridement, which ideally consists of surgical excision of the entire wound.<sup>24</sup> The possibility of employing this procedure under wartime conditions, with extensive, lacerated, contused and disrupted wounds, does not always exist. The ideal, however, should be approached as nearly as possible under the existing circumstances. Most gunshot wounds received in warfare are badly lacerated and contused. After proper anesthetization the wound is covered up to its edges with a plain gauze pack and the surrounding skin carefully shaved and thoroughly cleansed with soap and water and some fat solvent. The skin then, if desired, may be painted with an antiseptic up to the wound margins. The skin edges are then excised. Skin should not be unnecessarily sacrificed; frequently  $\frac{1}{4}$  inch is all that needs to be removed around the margin of the wound. Often the injury is more extensive than that of the skin wound itself, in which case adequate exposure must be obtained by further skin incision. This should be made in the longitud-

inal axis of the limb. All dirty and contaminated tissue and devitalized muscle must then be excised, preferably en masse. In wounds of the face the excellent blood supply permits a limited débridement, and mechanical cleansing should take the place of radical excision.<sup>11</sup>

Important nerves and blood vessels must be preserved whenever possible. Primary *nerve* or *tendon suture* should not be attempted under war conditions.<sup>5</sup> Secondary repair of these structures can be undertaken at a later date with far greater likelihood of success, especially if infection has been avoided during the primary treatment. Successful nerve suture may be performed up to two years after the original injury.<sup>1</sup>

*Foreign bodies* are located and removed, preferably by digital exploration. Eloesser<sup>5</sup> has pointed out that the use of x-ray in advanced stations is impracticable. Hofiman<sup>8</sup> agrees with this and states that it has been used in less than 5 per cent of cases.

**Packing and Immobilization.**—After excision of all dead and damaged tissue and removal of all foreign bodies, the wound should be thoroughly irrigated with normal saline, packed open, and the extremity immobilized in the position of function by the use of plaster. The only possible exceptions to this rule of avoiding primary suture are minor wounds of the head, hand, foot and wrist.<sup>5</sup> Minor wounds of the scalp may be sutured per primam provided a very thorough débridement has been performed. Otherwise such wounds are best left undisturbed until definite treatment can be given.<sup>18</sup> The packing used in the wounds may consist of plain gauze, vaselized gauze, or gauze smeared with some form of antiseptic paste, such as "Zisp." This is made up of equal parts of zinc peroxide, iodoform and sulfanilamide powder, with enough paraffin in to make a thin paste.<sup>5</sup> The use of gauze saturated with cod liver oil has also been favorably mentioned.<sup>23</sup>

#### ANESTHESIA

In mobile warfare dependence should be placed upon the simplest and most easily transportable anesthetic agents.<sup>17</sup> *Ether* and *chloroform* both fulfill these requirements, while anesthetic gases which must be transported in heavy cylinders

should not be relied upon. For extensive wounds requiring prolonged operation, general inhalation anesthesia will probably be necessary. *Brachial plexus block* in injuries to the upper extremity has been found by Eloesser<sup>5</sup> to be useful. Ten to 30 cc. of 1 per cent novocain containing 2 minims of 1:1000 solution of epinephrine hydrochloride to the ounce, is injected in and about the plexus by passing the injecting needle posteriorly 2 cm. above the middle of the clavicle. For other minor injuries *pentothal sodium intravenously* has been found satisfactory. Six to 8 cc. of a 5 per cent solution is injected intravenously for induction. A total of 16 to 18 cc. is necessary for a satisfactory anesthesia.<sup>25</sup> The use of 2.5 per cent solution of the drug is probably safer than the stronger solution.

### CONTROL OF HEMORRHAGE

First aid control of hemorrhage should always be attempted by *direct pressure* over the wound combined with elevation. Only in the rare cases where this is inadequate should a tourniquet be used. If a *tourniquet* is applied, it should be released every twenty minutes. Should the hemorrhage recur, it can then be reapplied. Where the patient has reached facilities for direct treatment of the wound the hemorrhage will of course be controlled by direct *ligation* of the bleeding vessels.

Under unusual circumstances it may occasionally be necessary to control hemorrhage by *packing the wound*. If this is done tightly there is a great danger of subsequent infection, particularly as under these circumstances débridement has probably not been adequate. If tight packing is used, it should be removed at the earliest possible moment. It is also dangerous to apply tight circumferential bandages over a wound in a limb for hemostasis. Such a bandage will later produce severe pain and great edema in the distal portion of the limb.<sup>19</sup>

### LOCAL AND ORAL CHEMOTHERAPY

The report of Jensen and coworkers<sup>10</sup> in 1939 on the local implantation of *sulfanilamide* in compound fractures was a great stimulus to the local use of sulfanilamide in many situations, particularly in traumatic wounds and compound fractures. The local use of the drug does not eliminate the neces-

sity for very adequate and thorough débridement, but it probably is a useful adjunct to such a procedure. The drug is absorbed into the general circulation and eliminated; consequently, it is advisable to supplement the local use with administration by mouth. An initial dose of 4 gm. should be taken orally as soon after the injury as possible. This should be followed by 1 gm. every four hours, for one week. In cases without evidence of infection the dosage may be diminished after two or three days. Where infection occurs larger doses will be required. Not more than 15 gm. should be placed in the wound. Five to 10 gm. are usually sufficient. Other sulfonamides may prove to be more efficient and less toxic, but their general use will have to await further study.

Chemotherapeutic agents are undoubtedly most efficient when used prophylactically and in the early stages of infection.<sup>3</sup> Sulfanilamide powder in the amount of 5 to 10 gm. can be sprinkled on a wound when the first aid dressing is applied, and the initial dose taken by mouth at the same time. When the wound is débrided, sulfanilamide powder can again be placed in the wound and the administration by mouth continued. Such use of sulfanilamide was found to be of considerable value in diminishing the incidence of streptococcal infection during the evacuation from Dunkirk<sup>20</sup> and in the fighting in Libya.<sup>19</sup>

Ross and Hulbert<sup>25</sup> do not routinely employ sulfanilamide either locally or generally. However, 50 per cent of their wounded were aviators in which cases the contamination seen in wounds of the infantry soldier from soil and dirt must have been largely absent.

#### COMPOUND FRACTURES OF THE UPPER EXTREMITY

**Closed Plaster Dressings.**—Probably the greatest change which has occurred in the treatment of war wounds has been the use of closed plaster dressings for compound fractures. Following the publication of Orr's book on this subject in 1929,<sup>21</sup> the closed plaster method was slowly adopted in the United States in the treatment of osteomyelitis. The remarkable results which could be attained by this method in the treatment of compound fractures were not generally appreciated



Fig 232.—Wound of upper third of humerus, produced by aerial bomb and not treated for twenty-four hours. Extensive débridement was performed before application of plaster. (Trueta, "Treatment of War Wounds and Fractures." Courtesy of Hamish Hamilton Medical Books, London, England )

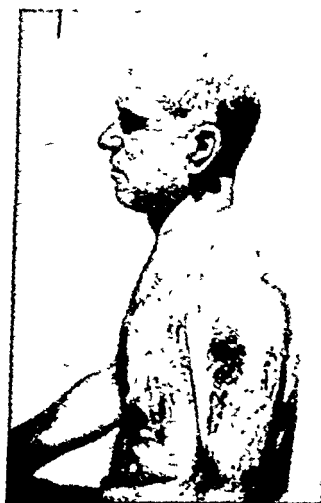


Fig. 233.—Same patient as in Fig. 232, seventy-five days later. Fracture had united but wound had not completely healed. Plaster was again applied. (Trueta, "Treatment of War Wounds and Fractures" Courtesy of Hamish Hamilton Medical Books, London, England.)

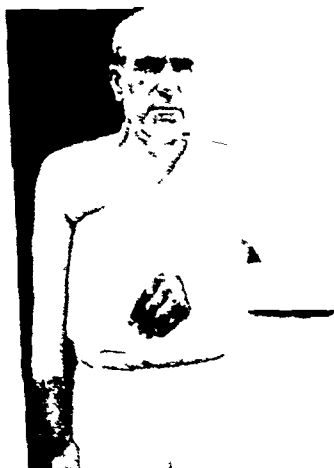


Fig 234.—Same patient as in Figs 232 and 233, after application of final plaster. (Trueta, "Treatment of War Wounds and Fractures" Courtesy of Hamish Hamilton Medical Books, London, England.)

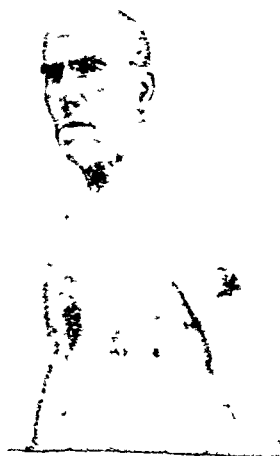


FIG 235 —End-result in case illustrated in Figs. 232 to 234 (Trueta, "Treatment of War Wounds and Fractures" Courtesy of Hamish Hamilton Medical Books London, England )

until the Spanish Civil War (Figs. 232, 233, 234 and 235). The best summary of this method and its results is to be found in Trueta's book.<sup>27</sup> The technic of the application of the plaster is excellently described by Eloesser.<sup>5</sup> He stresses the importance of placing plaster splints in position *before* applying the circular turns. Casts constructed in this manner are stronger and lighter than those made entirely by circular turns. It is also easier to split these casts longitudinally, which should always be done if patients must be evacuated shortly after the application of the plaster.

The operative treatment of the wound itself is similar to that outlined above in the treatment of flesh wounds. In addition, any loose bits of bone unattached to periosteum are removed. The bones are placed in proper alignment by traction and manipulation and held in place while the primary plaster splints are applied, followed by the complete circular cast.

All the wounds are packed open. Dry gauze was used in Spain but vaselinized gauze, "Zisp," cod liver oil, or gauze saturated with a sulfanilamide paste may be used. Wallis and Dillworth<sup>30</sup> have recently recommended gauze soaked in a 12 per cent solution of lactose for packing these wounds. Because fermentation takes precedence over putrefaction, they state that these casts do not develop a foul odor for periods up to four weeks.

Streptococcal septicemia was the most common cause of death in the wounded during the war of 1914-1918. In the bacteriologic studies of the closed plaster cast during the Spanish Civil War, streptococci could be grown from the wounds at almost any stage in the healing process,<sup>22</sup> but streptococcal septicemia was an extreme rarity. This appears to indicate the effectiveness of complete immobilization in preventing absorption from raw surfaces.<sup>21, 28</sup>

**Immobilization of Fractures.**—Abduction plaster casts for fractures of the *humerus* should not be used in advance stations.<sup>5, 6</sup> The arm in the abducted position interferes with transportation and exposes the part to injury. Immobilization by binding the arm to the chest is useful in emergencies. When possible a cast should be applied with the arm slightly abduc-

ted and in slight anterior flexion. The forearm should be at right angles to the arm and directed forward.<sup>12</sup>

*Splints.*—Except for actual litter work on the battlefield, *Plaster of Paris* is the ideal modern splint for use in the care of the wounded.<sup>13</sup> Plaster weighs more than other splints, but is less bulky and easier to transport. Furthermore, plaster can be adapted for use in any situation, whereas when other material is used a variety of splints for different purposes must be kept on hand and returned to the forward areas when they are removed from the patient. Finally, the immobilization achieved by plaster during the transportation of the wounded cannot be obtained by any other means.

### SUMMARY

1. In modern warfare a medical organization will be most efficient when it is built up of small surgical units which possess their own means of transportation and supplies. Such units can be set up quickly to take care of casualties close to the scene of action. When many units are combined they may serve as an evacuation or general hospital, in association with other specialty units.

2. Burns of the hands and face should not be treated with tannic acid.

3. Débridement, ideally wound excision, is still the essential basis of treatment of gunshot wounds.

4. Primary suture should never be employed in contused, lacerated gunshot wounds.

5. Sulfanilamide, locally and generally, should be employed in all patients with traumatic wounds.

6. The closed plaster of Paris dressing has been proved to be the ideal primary treatment of compound fractures and extensive flesh wounds.

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## DISORDERS OF THE FOOT IN RELATION TO MILITARY SERVICE

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THE present standards of living, with sedentary occupations and increasing transportation facilities, have produced such decided weakness of the feet that in many instances the additional hardships of military duty cause considerable disability. The average man neglects the proper attention to his feet, being unaware of trouble until he has discomfort. Furthermore, as a majority of the medical practitioners show little interest in foot disorders the general public seeks relief wherever it is offered, and thus care of the feet frequently is entrusted to unqualified persons. The members of our professions are responsible for this situation, as they alone are capable of examining and treating such conditions.

In the selection of men for military service we must study the functions and requirements of the foot in order to eliminate those who are unfit; likewise, we must recognize and treat the various minor affections in their incipiency and thus prevent serious consequences. It is readily understood that the efficiency of a fighting unit to a great extent depends upon the condition of the soldiers' feet. Only strong feet can withstand the strain, and many of those which have been weak but symptomless will "break down" when subjected to long marches and carrying full equipment. Even with the careful selection of men for the service and proper fitting with regulation shoes a great deal of foot trouble develops during active duty. Thus the importance of examining the foot intelligently in order to recognize the various disorders and potential disabilities is obvious.

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In the selection of men for military service we must study the functions and requirements of the foot in order to eliminate those who are unfit: likewise, we must recognize and treat the various minor affections in their incipency and thus prevent serious consequences. It is readily understood that the efficiency of a fighting unit to a great extent depends upon the condition of the soldiers' feet. Only strong feet can withstand the strain, and many of those which have been weak but symptomless will "break down" when subjected to long marches and carrying full equipment. Even with the careful selection of men for the service and proper fitting with regulation shoes a great deal of foot trouble develops during active duty. Thus the importance of examining the foot intelligently in order to recognize the various disorders and potential disabilities is obvious.

## ANATOMY AND FUNCTIONS OF THE FOOT

The foot is composed of a group of bones held together and suspended by ligaments and muscles. Its general shape resembles a tripod, with the apex at the heel and its base extending from the ball of the great toe to the ball of the little toe. In the long axis of the foot there is a decided bony arch, which although extending under its entire width may be considered for practical purposes as being on the inner side only. This *longitudinal arch* extends from the os calcis to the astragalus through the scaphoid, internal cuneiform and first metatarsal bones. Its strength is maintained by the long and short plantar ligaments connecting the individual bones, and the tibial muscles and short flexors of the toes.

The so-called *transverse arch* is not literally an arch. Actually the body weight in standing and during locomotion is distributed equally to all of the metatarsal bones excepting the first, which is more heavily constructed and bears twice as much weight as the others. The heel is well padded and adapted to its function of bearing weight while standing, whereas the forefoot which provides propulsion is of lighter construction, is flexible and gives a spring to the gait. In the standing posture weight is borne equally by the heel and ball of the foot, and is evenly distributed between its inner and outer borders. In stepping the weight is transmitted forward to the metatarsal area. During walking the feet are practically parallel, but in going over rough or unsteady surfaces they are abducted or rotated outward for greater stability. While walking the muscles are alternately contracted and relaxed, thus providing better circulation and momentary rest of the muscles, whereas during prolonged standing the muscles undergo even greater fatigue with continued strain.

## EXAMINATION OF THE FOOT

In determining fitness for military duty the *general build* is significant. A short, stocky individual is not often subject to foot strain; on the other hand a tall, thin individual usually has long and narrow feet which are decidedly liable to strain. Poor posture with a flat chest, rounded or drooping shoulders, lumbar lordosis and protuberant abdomen usually is accom-

panied by relaxation and faulty posture in the feet and ankles which predispose to foot strain.

Deformity in the lower limbs tends to produce foot disorders. Thus *knock-knee* often affects the foot because it alters the normal perpendicular line of weight-bearing through the patella to the middle of the astragalus to the second metatarsal bone, and causes chronic strain from pronation or valgus position of the foot. This strain may be aggravated by prolonged marching and increased load. Likewise, *bow-leg* changes the line of weight-bearing and produces a strain on the external lateral ligament of the ankle and on the inner border of the foot.

In the local examination the foot should be observed in repose, in standing and in walking. First it is important to note the *posture* and *gait* before the shoes are removed. The *condition of the shoe* is significant, as bulging on the inner border, and excessive wear on the inner or outer border of the heel and sole indicate an abnormal foot which usually will cause disability for military purposes. A rounded sole or a hole in the sole under the ball of the foot indicates weakness with accompanying depression of the metatarsal bones.

Next the bare feet should be examined in repose. Corns over the toes denote abnormal posture, flexion deformities or pressure and friction from a shoe which either is too tight or fits badly. There also may be corns between the toes, caused by narrow shoes. An *exostosis* with bursitis may be found on the dorsum of the foot, and is a result of tight lacing over the abnormally high instep which accompanies a contracted foot. A *hammer-toe deformity* is characterized by an extension contracture at the metatarsophalangeal joint and a flexion contracture at the interphalangeal joint, and usually affects the second toe. *Bunions* are commonly associated with a flat-foot condition, the lateral deviation of the great toe being accompanied by enlargement over the dorsal and inner aspects of the joint. "Tailor's bunion" is an enlargement with exostosis over the fifth metatarsophalangeal joint. The *color* of the foot and leg should be noted, and if the foot is discolored the dorsalis pedis and posterior tibial arteries are palpated to determine their patency. *Swelling* over the ankle usually indicates chronic

strain in both ankle and foot. Swelling when accompanied by tenderness denotes an inflammation with a variety of causes.

A normal foot has been defined as one which throughout life shows no subjective or objective signs of pathology. *Bulging* over the inner border of the foot in the region of the scaphoid bone, with abduction deformity and sagging, indicates chronic weakness and strain of the ligaments and muscles. The *height of the long arch* is an individual variation, and is not the chief factor in determining acceptability for active duty.

Under certain conditions, a foot which appears normal may be painful and disabling; conversely, a foot which appears abnormal may never cause pain or disability. Many weak feet are not flat, and many flat feet are not weak. A man of sedentary habits who is not accustomed to walking and carrying loads may have normally shaped feet, but these feet often cause complete disability when subjected to prolonged strain from drilling and carrying a pack on the back; whereas the feet of a mechanic or laborer which often are flattened will not produce symptoms because the muscles and ligaments are strong. Such experiences were observed during the World War I, when laboring men with flat feet first were rejected but later were found to be fit for active duty.

When the long arch is abnormally high, with a correspondingly high instep, the foot is short and the toes are contracted; such a deformity is known as *clawfoot*, and is disabling on account of painful corns over the toes and bursitis with caluses which form under the metatarsophalangeal joints.

The *tone and general development of the muscles* in the forefoot and in the calf of the leg are determined by watching the active movements in various directions. Spasticity of the muscles, especially of the peroneal group with inability to adduct the foot, is common in acute foot strain. When it is impossible to dorsiflex the ankle to within a right angle on account of a short Achilles tendon there is chronic foot strain, as the weight of the body is not distributed evenly.

*Tenderness* over the astragaloscaphoid joint and over the plantar fascia is common with foot strain. Tenderness under the metatarsal bones is due to bursitis and metatarsalgia. Tenderness over the base of the great toe most often is due to in-

inflammation of the joint or of the sesamoid bones beneath the joint. Tenderness over the weight-bearing surface of the heel is caused by either a bursitis or periostitis with spur formation, and tenderness on the back and sides of the heel is typical of periostitis. Enlargement and tenderness at the insertion of the Achilles tendon on the heel are due to achillobursitis, which when acute is caused by pressure of a new shoe or overuse. With chronic achillobursitis there is an underlying exostosis.

*x-Ray examinations* are helpful for diagnosis and in cases having deformity or disease, but cannot be relied upon to prove or disprove fitness for military service in instances of faulty mechanics. When interpreting the films it is important to remember the supernumerary bones which may be present, as these may be mistaken for fractures.

#### PHYSICAL STANDARDS FOR THE FEET

(United States Selective Service Regulations, October 18, 1940)

##### *Acceptable Conditions for Class 1-A*

Pes planus unless accompanied by marked deformity, rigidity, or weakness, or of such degree as to have interfered with useful vocation in civil life.

Hallux valgus unless severe.

Clubfoot of slight degree if tarsal, metatarsal and phalangeal joints are flexible and the condition permits the wearing of a military shoe and, in the opinion of the examiner, will not interfere with the performance of military duty.

Slight claw toes not involving obliteration of the transverse arch and which do not interfere with the wearing of a military shoe.

Hammer toe which is flexible and which does not interfere with the wearing of a military shoe. (Hammer toe usually involves the second digit and unless it is rigid is not a disqualifying defect.)

Absence of one or two of the small toes of one or both feet if the function of the foot is good.

Ingrowing toenails.

##### *Acceptable Conditions for Class 1-B*

Abduction and pronation (knock-ankle) when this condition is not associated with rigidity of the tarsal joint or with deformity of the foot. (This defect is remediable with proper foot exercises and with correct shoes.)

Loss of great toe.

Loss of dorsal flexion of great toe.

Hammer toe with rigidity.

Other defects of the feet which disqualify for general military service but do not prevent the registrant from wearing a military shoe and which have not prevented him from following a useful vocation in civil life.



*Conditions Which Warrant Rejection (Class 4)*

Pes planus, if accompanied by marked deformity, rigidity, or weakness, or of such degree as to have interfered with useful vocation in civil life.

Obliteration of the transverse arch associated with permanent flexion of the small toes (claw toes).

Hallux valgus if severe and associated with marked exostosis or bunion, especially when there are signs of irritation above the joint.

Clubfoot if marked in degree or which interferes with the wearing of a military shoe.

Amputations of extremities in excess of those already cited.

## EFFECTS OF TRAUMA AND EXPOSURE

**Acute Foot Strain.**—This condition exists when the load is out of proportion to the strength of the muscles which support the feet. Frequently men who come from sedentary occupations suffer from acute foot strain when they enter military life, on account of the sudden increase in load by additional equipment. In addition to the common symptoms of aching in the long arch, in the sole and under the ball of the foot there may be aching under the heel and in the muscles of the leg. These symptoms vary from mild aching to severe pain causing complete disability. There is accompanying tenderness, and in severe cases the feet and ankles are swollen. Acute foot strain also may appear after prolonged illness with general weakness from debility and inactivity.

*Treatment* consists of complete rest or restricted use, according to the severity of the condition. In the average case adhesive strapping applied to support the ligaments of the ankle and foot in the inverted position gives prompt relief. The inner border of the heel of the shoe should be tilted by the addition of a  $\frac{1}{4}$ -inch wedge of leather, or a long arch support made of felt may be provided.

**FOOTWEAR.**—Most of the foot disorders in enlisted men can be prevented by early recognition and simple treatment. The regulation shoes are of approved shape and construction, but may produce corns, calluses and metatarsal pain unless they are of the proper length and width. Shoes too long produce friction and cause as much trouble as shoes which are too short. They should be broad enough to permit easy action of the forefoot. As a general rule, the average foot in weight-

bearing spreads  $\frac{1}{2}$  inch in length and width, and a shoe tried on while in repose should be a thumb's breadth longer than the foot and correspondingly broader.

**Traumatic "Flatfoot."**—Traumatic "flatfoot" or sprain of the foot is caused by a sudden wrenching injury as in jumping, or by a heavy object falling on the dorsum of the foot. The symptoms are essentially the same as in acute foot strain, only more localized, and the treatment is similar.

**Chronic Foot Strain.**—This is present when the muscles and ligaments lack tone and the feet are relaxed, but may cause fatigue and disability only after active military duties have been commenced. The aching is in proportion to the amount of strain, and frequently is as severe in the legs, knees, hips and even in the lower back as it is in the feet themselves. When such a condition is found during examination for military service the applicant should be placed in Class 1-B. If it develops after enlistment the man should be transferred to another form of duty.

**Spastic "Flatfoot."**—This painful condition is due to muscle spasm and consequent rigidity. In some instances this spasticity is caused by overuse of an already strained foot; in other instances there is an inflammatory element or other factors such as focal infection, grippe, or exposure to cold and dampness. The spasm affects chiefly the peroneal muscles, with consequent valgus or eversion deformity.

*Treatment* consists of complete rest and the application of heat, followed later by adhesive plaster strapping and wedging of the shoe or the use of arch supports. In resistant cases which do not respond to these simple measures the foot and ankle must be manipulated into the overcorrected position, and this position maintained by plaster of Paris for six weeks. After removal of the plaster cast, exercises, strapping and corrective shoes are used.

**Arthritic "Flatfoot."**—Arthritic "flatfoot" is a disabling condition in which an inflammation from focal infection or exposure to cold and dampness is superimposed on a preexisting foot strain or pes planus. When this condition occurs in young men gonorrhea is a frequent cause. The amount of pain varies,

in some instances being severe and accompanied by so much swelling and tenderness that the patient is bedridden or must use crutches for many weeks or months.

*Treatment* consists of rest, local application of heat, hyperpyrexia, injections of foreign protein and shock therapy, followed by gradual weight-bearing as the inflammation subsides. The early use of sulfathiazole in the treatment of urethritis is of unquestionable value in the prevention of gonorrheal arthritis.

**Metatarsal Pain and Metatarsalgia.**—Pain of metatarsal origin in males most often accompanies general weakness of the foot, and may be the only symptom of such weakness. *Morton's toe* or *metatarsal neuritis* is characterized by severe pain which often appears suddenly, with a cramplike sensation in the fourth toe, and usually is relieved by removing the shoe and squeezing the foot to create an arch-shape in the metatarsal area. This condition is attributed to pressure of the metatarsal bones upon the digital nerves. Metatarsal pain and callosities may be due to congenital shortness of the first metatarsal bone, with the resulting strain and pressure upon the second metatarsal head.

Pain in the metatarsophalangeal joints also may be due to stone-bruise and overuse as in driving automobiles, which produce a traumatic synovitis or bursitis.

*Treatment* consists of providing shoes which are long enough to permit the toes to straighten, adhesive strapping encircling the metatarsal area of the entire foot, and fastening a felt or sponge rubber pad to the insole of the shoe behind the heads of the metatarsal bones.

**Corns.**—Corns and calluses are often so painful as to cause disability. The causes of corns include short and tight socks and shoes which produce flexion of the toes and consequent friction in the shoe, faulty posture of the foot as *pes planus* with unequal distribution of weight-bearing, and contractures as hammer toe and clawfoot.

*Treatment.*—The treatment of corns consists in relieving pressure by the use of pads and properly fitting footwear, chiropody, and correcting faulty posture or deformity if present. The common corn over the fifth toe forms because the

foot is supinated or turned over to ease the strain of weight-bearing, and in most instances the pressure can be relieved simply by adding a wedge of leather to the outer border of the sole of the shoe. Under chronic corns there is an inflamed bursa, which may become infected and cause severe pain. The surgical removal of corns often is disappointing, on account of the painful neuritis which remains. A *soft corn* between the toes is due to tight shoes and can be relieved by padding with lamb's wool, but cannot be cured except by removing the underlying small exostosis.

**Calluses.**—The calluses which result from improper posture of the foot cause severe burning and a limp. Weakness of the foot may produce a callus under the great toe or under the small toe, depending upon the position assumed. Calluses under the ball of the foot, under all of the metatarsophalangeal joints and especially at the base of the third toe, are common with metatarsalgia and flatfoot. These are especially severe in clawfoot, with contracture of the long arch and convexity of the ball of the foot.

**Treatment.**—Calluses should be removed periodically with a corn file or sandpaper, and the faulty posture corrected by shoe changes including the addition of pads to the insole to equalize the weight-bearing.

**Blisters.**—Blisters from new and stiff shoes or large socks sometimes have serious consequences. Every tender or reddened area should be protected by fastening a patch of adhesive plaster smoothly over the skin where there is unusual pressure or friction. If a blister forms regardless of this protection it should be opened with a sterilized needle to release the serum, and then covered with absorbent cotton and adhesive plaster; the overlying skin should not be removed unless the blister becomes infected. If the skin is broken it should be trimmed off and the base painted with gentian violet solution or with a solution of tannic acid.

**Plantar Warts.**—Plantar warts, or verrucae plantaris, usually occur under the ball of the foot, and commonly are induced by pressure from faulty foot posture or by the irritation of foreign bodies as a grain of sand or a projecting nail in the shoe. Plantar warts are contagious, being due to a virus,

and often multiply. These warts do not grow as high as papillomata, but as their bases are deep they cause severe pain, especially when located under the metatarsophalangeal joints.

*Treatment* first of all consists of relieving weight-bearing pressure by padding and proper shoes. Single warts can be treated most satisfactorily by complete excision, but for multiple or coalescing warts x-ray therapy is best. If x-ray therapy fails, injection of bismuth intragluteally may be successful.

**Bursitis.**—Bursitis develops over prominent joints as in hammer toes and bunions. It usually is chronic and relatively painless, but may be aggravated by a single injury or pressure from improperly fitting shoes. A painful bursitis forming over the dorsum of the foot on account of a high instep is seen in contracted feet, and is caused by pressure of the shoe which fits tightly over this area.

*Treatment.*—Bursitis over the toes responds to relief of friction and the application of pads; occasionally a bursa becomes infected and drainage is necessary. The treatment of chronic painful bursitis is excision of the bursal sac and also removal of the exostosis or bony deformity under it. Bursitis under the ball of the foot which occurs in automobile drivers is usually relieved by padding and adhesive strapping, and changing the position of the foot on the pedal.

**Painful Heel.**—This condition may be due to foot strain, stone-bruise, fasciitis, calcaneal bursitis, retrocalcaneal bursitis, generalized periostitis, or local periostitis with spur formation. Aching under the heel at the attachment of the plantar ligament and flexors of the toes to the os calcis, without tenderness, is due to *foot strain*; this aching is relieved by rest and correction of the strain by support. Pain in the soft structures over the heel on account of a contusion or *stone-bruise* is relieved by padding with a rubber sponge or a felt ring. *Calcaneal bursitis*, or inflammation of the bursa which is situated at the attachment of the plantar ligament to the os calcis, occurs typically with gonorrhea and is treated by rest and attention to the gonorrhea. The pain and tenderness in the sole of the foot at the attachment of the plantar fascia to the tubercle of the os calcis is typical of *fasciitis*, being aggravated by weight-bearing and the tension produced by dorsiflexing the

ankle. This is treated by rest and application of heat, with attention to focal infection.

Contrary to a rather general impression the *exostosis* or *spur* which x-ray films show on the weight-bearing surface of the heel is not gonorrheal in origin, but is the result of long-continued weight-bearing and therefore is known popularly as "policeman's heel." In many instances the spur does not cause symptoms, but if there is pain it can be relieved by placing a sponge rubber pad in the shoe under the heel, operative removal seldom being necessary.

Chronic pain and tenderness over the os calcis is caused by a *generalized periostitis*, and this is very resistant to any form of treatment. Between the posterior surface of the os calcis and the Achilles tendon is the *retrocalcaneal bursa*, which may become inflamed on account of pressure by a new shoe, with resulting pain and disability. Inflammation of this bursa in the acute state is treated by avoidance of pressure, and if it becomes chronic the bursal sac and underlying portion of the bone should be removed. Inflammation of the bursa which lies between the tendo achillis and skin is known as *achillobursitis*. This is caused by the pressure of tight shoes, and is relieved by removing the cause.

**Tenosynovitis.**—Inflammation of a tendon and its sheath usually is caused by excessive use or pressure, the Achilles tendon being affected most often. Pressure from new shoes which fit badly often affects the extensor tendon of the great toe. With tenosynovitis there is local swelling and pain on movements, with characteristic crepitation.

**Treatment.**—Acute Achilles tenosynovitis requires complete rest for two weeks or longer, following which adhesive strapping is applied and the heel of the shoe is raised  $\frac{1}{2}$  inch to relax the tendon. Neglect is followed by chronic inflammation, with thickening of the sheath and prolonged disability.

**Deformities of the Toes.**—*Bunion*, or hallux valgus, is a lateral angulation deformity at the metatarsophalangeal joint of the great toe accompanied by exostosis formation, both of which vary according to the deflection of the joint and the amount of pressure made on it by the shoe. In nearly every case there is an accompanying bursitis over the joint, and oc-

casionally the bursal sac becomes infected. In a majority of instances a bunion will cause little discomfort or disability if a broad shoe is provided. The comparative rarity of this condition in men as compared with women is explained by the difference in footwear. Operation seldom is necessary in the male subject, except for incising an acute suppurative bursitis. "Tailor's bunion," an exostosis and bursitis over the metatarsophalangeal joint of the fifth toe, is caused by a badly fitting shoe, and is relieved by wearing a broader shoe with a wedge added to the outer border of the sole.

*Hammer toe* is a contracture usually found in the second toe, the flexion deformity in the proximal interphalangeal joint being painful on account of an overlying bursitis and corn. In mild cases a larger shoe with a soft box gives relief, but advanced hammer-toe deformity requires operative treatment. This operation can be done easily under local anesthesia and consists of excising the joint surfaces after removing an elliptical portion of the overlying skin with the corn and bursa.

*Claw toe* is a fixed flexion deformity involving all the toes, which causes disability on account of corns and pain in the ball of the foot. Operative correction of the claw foot relieves the toe contractures, although the spring of a natural gait cannot be restored.

*Subungual exostosis*, or enlargement of the dorsal portion of a phalanx, is accompanied by a large and horny nail, and in nearly every instance involves the great toe. Removal of the nail gives temporary relief, but another horny nail will form within a few months unless the underlying exostosis is excised.

**Ingrowing Nails.**—The nails should be kept short and always should be trimmed straight across and not in a curve. If the corners of the great toenail are torn or cut off the sides of the nail turn downward, and the consequent irritation produces an infection. To prevent this the corners of the nails which grow downward should be lifted upward and kept separated from the skin with a pledget of lamb's wool. The middle of the nail may be scraped thin with the edge of a knife blade, thus causing the two sides of the nail to become flattened. For chronic ingrowing nail a minor operation which con-

sists of removing an elliptical portion of the soft structures on the side of the toe often is satisfactory, although complete excision of the matrix is necessary for more severe cases.

**Sesamoiditis.**—This painful condition of one or both sesamoid bones at the base of the great toe is caused by trauma as a blow on the dorsum of the foot. Occasionally the internal sesamoid is fractured. Treatment consists of protecting the painful area with a felt ring, and relief from military duty for a short period. If there is a fracture or chronic pain, removal of the bone may be necessary.

**Sprain of the Ankle.**—Sprain usually involves the anterior and middle bands of the external lateral ligament, and causes pain and swelling over the outer border of the foot at the insertion of these bands. The twist causing this injury stretches the peroneal tendons severely and frequently produces an accompanying synovitis of the ankle.

**Treatment.**—The ankle should be compressed and supported by adhesive plaster strapping, with the strips of adhesive plaster applied while the foot is held abducted or turned outward. The addition of a wedge to the outer border of the sole of the shoe is helpful in preventing subsequent twists of the ankle, and it is important to keep the heel repaired.

**Minor Fractures.**—Minor fractures of the foot are produced by indirect injury such as a twist, and are most common in the *shaft of the fifth metatarsal bone*. Sudden torsion produces a spiral fracture, and as there is little or no displacement of the fragments and only moderate pain the fracture may not be recognized until an x-ray examination is made. These fractures are treated satisfactorily by adhesive strapping, wedging the outer border of the sole and restricted activities for from two to four weeks.

Avulsion or sprain fractures at the *base of the fifth metatarsal bone* are seen occasionally, being produced by a sudden pull of the peroneal tendon which is inserted on this bone; this injury may be treated by adhesive plaster strapping.

Fractures in the *distal phalanges* of the toes are frequently caused by stubbing injuries, and also by direct blows. This injury requires no other treatment than drilling a hole in the



nail for evacuation of the hematoma and a loosely fitting shoe, and does not cause disability.

**March Foot.**—This condition, also called "march fracture," is a subperiosteal fracture in the second, third or fourth metatarsal bone which occurs spontaneously after prolonged use as in marching, without a history of severe traumatism as a blow. Most of these occur in men of slight build who are not physically conditioned on account of sedentary occupations. There is sudden onset of pain and swelling localized to the dorsal and plantar aspects of the foot, accompanied by a limp. In many instances an x-ray examination soon after the onset of symptoms shows no abnormality or only a fine fracture line may be visible, although after ten days a re-examination reveals a distinct subperiosteal fracture with a spindle-shaped mass of callus forming in the blood clot under the periosteum. Whenever metatarsal pain and swelling occur after prolonged walking or marching, x-rays should be made to exclude this condition. Treatment consists of resting the foot for four weeks until the fracture has united, by which time the pain and swelling have subsided.

**Frost-bite.**—Frost-bite, or chilblain, is of sudden onset, being caused by exposure to cold. The parts chiefly affected are those having the least circulation, as the toes and back of the heel. A high wind is a definite contributing cause, and in aviators a deficiency of oxygen is an important factor. As the initial burning sensation from exposure to severe cold subsides the affected part becomes numb, and this is a dangerous period to the unsuspecting person. At this state the skin is white and the toes become stiff. The result varies from complete recovery to ulceration or even gangrene of the superficial and deep structures, according to the severity of exposure and the treatment.

**Treatment.**—Prophylactic treatment consists of wearing properly fitting socks and shoes, and adequate clothing for the entire body. The shoes should be kept well oiled and dry socks should be worn. In the acute stage of chilblain it is important to avoid the local application of heat and rubbing. The foot should be kept elevated and at first wrapped in woolen clothing for a few hours, then heat should be applied and

gradually increased to the temperature of the body, likewise the patient's body should be kept warm. When blebs are present they should be kept covered with sterile gauze, and even if gangrene appears imminent the affected part at first should be treated expectantly and not by amputation, as in many instances the ultimate destruction of tissue does not extend deeper than the skin. As the first attack predisposes to future attacks, advice and warning as to prevention is important.

**Trench Foot.**—Trench foot is a neurocirculatory disturbance caused by prolonged exposure to cold and dampness. This condition was common in the trench warfare of World War I, when men stood for long periods with inactive muscles in dampness and mud. The feet at first are numb and later severe burning pain and swelling develop, being worse after removing the shoes. The skin, which originally is white, later becomes mottled and dusky red. Blisters containing bloody fluid appear, ulcerations may form, and severe neuritis also is present. In extreme cases the toes turn black, the nails become loose, and moist gangrene follows.

*Treatment.*—Prophylaxis consists of avoiding tight socks and shoes, wearing dry socks and keeping the shoes well oiled, and exposing the feet to the combination of cold and dampness as little as possible. This condition is treated by rest in bed with the feet elevated, combined with application of heat which is increased gradually to body temperature. Blebs should be covered with sterilized gauze. As with chilblain one attack predisposes to further trouble, and prophylaxis should be emphasized.



## GASTRO-INTESTINAL PROBLEMS IN MILITARY MEDICINE\*

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EXPERIENCE already gathered in the present war attests to the important role that diseases of the gastro-intestinal tract assume amongst military personnel. In the British forces disorders of the stomach and duodenum alone have outclassed in the rate of incidence all other medical diseases in those patients sent back from the front.<sup>1</sup> During the period between the dispatch of the British Expeditionary Force and April 29, 1940, 12.5 per cent of all patients evacuated to the United Kingdom had a primary diagnosis of gastric or duodenal disease.<sup>2</sup> This represents only a portion of the total dyspeptic cases that were in the base hospitals in France and is exclusive of the considerable number of patients suffering from disorders of other parts of the digestive tract.

**Special Factors in Gastro-intestinal Disease in the Military Forces.**—From the standpoint of the principles of diagnosis and treatment, the diseases of the digestive system are essentially alike in both civil and military practice. They are modified in the latter, however, by several factors: first, the relative frequencies of the various clinical entities are altered because one has to deal with a specially selected group of young and middle-aged males; second, the abrupt change in habits of living and eating, the increased exposure resulting from camp life, field maneuvers and the close personal con-

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tacts as well as the mental hazards of possible armed warfare will all help to rekindle digestive ailments that may have been quiescent or to initiate such ailments in certain susceptible individuals; third, in most instances proper investigation and treatment cannot be accomplished in the usual outpatient manner but require instead removal to a hospital or to an area where fixed installations of that character are located.

In this discussion the various digestive disorders that are likely to be encountered in military practice will be briefly considered in the light of the current concepts of their diagnosis and treatment.

### CARDIOSPASM AND ESOPHAGOSPASM

Both of these conditions deserve some mention because of the important fact that they can be precipitated by emotional disturbances alone. They are characterized in the main by *dysphagia* and *pain* which at the onset are intermittent in character. The pain is of particular importance because it may simulate that of angina pectoris, or of disease of the stomach or gallbladder. Pain is usually situated in the retrosternal region but it may extend to the epigastrium, to the back in the neighborhood of the tenth and twelfth dorsal vertebrae, upward along the anterior portion of the thorax into the cervical and mastoid regions or to the angle of the jaw or into one or both external auditory canals. It may be precipitated by meals or it may occur independent of the ingestion of food or liquids.

The most important *diagnostic procedure* is the roentgenoscopic observation of actual spasm in the barium filled esophagus or the demonstration of arrest in the passage of the barium fluid or a barium filled capsule. Dilatation of the esophagus above the area of obstruction may or may not be seen and when present is indicative of a process of some standing.

**Treatment.**—An adequate therapeutic regimen is as yet lacking. It is desirable that these individuals avoid fatigue, nervous strain and anxiety. Atropine, belladonna, the nitrites and papaverine have all been used to induce relaxation but the results have not been uniformly satisfactory. Dilatation by means of sounds and hydrostatic dilators is widely employed, with striking temporary improvement in many cases.

In severe and advanced cases recourse must be had to various surgical procedures of which esophagogastrostomy promises to be the most successful.

### GASTRITIS

Bouts of acute gastritis, as after alcoholic excesses or in the ingestion of various irritants, are fairly common and readily recognized. There is still some skepticism, however, as regards the entity "chronic gastritis," interest in which has undergone a renaissance in recent years. Chronic inflammatory changes in the gastric mucosa have been reported in a surprisingly high percentage of individuals who have been examined with the flexible gastroscope. Attempts to correlate symptoms with the gastroscopically observed changes have thus far yielded nothing sufficiently characteristic to be of much diagnostic value. Generally, the *clinical picture* is characterized by the appearance, shortly after the ingestion of food, of vague, indefinitely localized, epigastric sensations of fullness, burning or discomfort. Anorexia, slight nausea and vomiting are fairly frequent symptoms. In a certain number of patients a fairly typical history of peptic ulcer may be obtained and even hemorrhage and melena have been noted.

There has been no correlation demonstrated between the degree of acidity of the gastric contents and the gastroscopic appearance of the stomach. *Diagnosis* rests upon the suggestive findings of alterations in mucosal pattern in the roentgenogram and especially upon the direct visualization of mucosal changes with the flexible gastroscope.

**Treatment.**—Therapy is essentially that employed in the management of peptic ulcer, with two additions. Those patients with anacidity or subacidity, particularly if they have diarrhea, are given hydrochloric acid with meals. In some cases, where the exudative reaction is marked, repeated gastric lavage with dilute solutions of hydrogen peroxide is employed. In all cases increased vitamin intake and iron and liver for the frequently associated anemia are valuable therapeutic adjuncts. Close attention to all chronic and recurrent infections of the upper respiratory tract is highly important. This is especially true in those patients with sinusitis and a postnasal drip, most

of whom swallow considerable amounts of the infected material in the course of a day.

### PEPTIC ULCER

The importance of this common organic disease in the armed forces is amply borne out by the experience of the British.<sup>3</sup> Approximately 85 per cent of a group of officer and enlisted personnel who complained of dyspepsia were found to have some type of peptic ulcer.<sup>2</sup> In the vast majority, furthermore, the onset of the disease antedated induction into military service. It is in the ulcer group, particularly, that closer attention to the alimentary history and, when indicated, the zealous use of radiologic and other special types of examination at the time of induction may avoid the selection of actual or potential digestive invalids. Not only do these individuals present a major problem while they are in the services, but in the post-war period they constitute an economic burden of staggering proportions. Every effort expended to weed them out in the very beginning is justified.

The natural history of peptic ulcer is one of almost regular recurrences and spontaneous *remissions*. The influence of mental anguish, tensional states and respiratory infections in the precipitation of recurrences is notorious. It is to be expected, therefore, that a considerable number of individuals with healed or quiescent ulcers will suffer the phenomena of reactivation as a result of military service.

**Treatment.**—The therapeutic approach must always be from the broad vista of the patient *as a whole* and not from the isolated view of an organic lesion in the stomach or duodenum. It is as essential to appease the psychic upset, rest the emotional drive, treat grossly infected sites particularly in the oral cavity, eliminate food allergens, correct all vitamin deficiencies, combat anemia, and improve the general hygiene, as it is to modify the dietary regimen. *Neutralization therapy* still enjoys wide popularity although there is increasing evidence and a growing feeling to the effect that the degree of gastric acidity per se is not as essential a factor as it hitherto has been considered. The traditional Sippy powders of sodium bicarbonate, calcium carbonate, magnesium oxide and bismuth

subcarbonate have been largely replaced by the newer colloidal suspensions of aluminum hydroxide or phosphate and by magnesium trisilicate. The older alkaline powders are still the most effective means, however, of relieving the severe pain which is encountered from time to time in some ulcer patients. Smoking and alcoholic imbibition are absolutely taboo and this is particularly to be emphasized in dealing with military personnel where both are possibly indulged in to excess.

**HEMORRHAGIC ULCER.**—The treatment of the bleeding ulcer has become a controversial subject in recent years since the advent of the *Meulengracht regimen*. Meulengracht, and others who have since rallied to his banner, contend that a full stomach is quieter than an empty one and that it is essential to furnish blood-forming food elements and to maintain nutrition in ulcer patients who have bled. Accordingly, they administer at once a varied diet that contains meat and fish amongst other things. Proof is as yet lacking that in large comparable series the mortality is any less with the Meulengracht regimen than with the more conservative type of management. Until such proof is forthcoming most gastro-enterologists still prefer to follow a procedure consisting essentially of nothing by mouth during the first twenty-four hours or so, followed by albumin water and progressing slowly to milk and the ordinary ulcer dietary. Dehydration, shock, chemical imbalance, and low renal filtration pressure are combated by the judicious administration of *parenteral fluids* in the form of intravenous whole blood or plasma and hypodermoclyses of normal saline, distilled water and glucose.

It must be remembered in approaching the treatment of these patients that individualization is necessary. The vast majority of deaths occur in those over the age of forty-five and, contrary to popular belief, with the initial rather than with subsequent hemorrhages. Early *surgical intervention* in the form of ligation of the bleeding vessel, therefore, is to be strongly considered in elderly, sclerotic individuals.

**PYLORIC OBSTRUCTION.**—Pyloric obstruction is no longer advanced as an indication per se for surgery in patients with peptic ulcer. In many instances the obstruction is due alone, or in large part, to spasm and edema. Partial to complete sub-



sidence may be brought about in a considerable number of cases by a *stomach rest program* in which only easily handled fluids are given by mouth; normal saline solution, glucose, plasma and vitamins are administered parenterally to maintain fluid balance and nutrition; heavy doses of antispasmodics and sedatives such as belladonna and phenobarbital are given to allay spasm; and the stomach is emptied daily or twice daily by tube. *Gastro-enterostomy* or *gastric resection* is reserved for those who fail to respond after some six weeks of this regimen.

PERFORATED PEPTIC ULCER.—This condition is a surgical emergency that undoubtedly has been well discussed elsewhere in this symposium. Suffice it to repeat here that the earlier the operation the lower the mortality.

#### CARCINOMA OF THE STOMACH

For the most part the medical officer will have to deal with personnel younger than the usual age groups in which cancers are seen. Carcinoma of the stomach, however, ranking as it does as the most frequent malignant tumor of the gastrointestinal tract and affecting as it occasionally does those of younger ages, is worthy of a short note.

Most physicians are schooled in the typical picture of upper abdominal pain, progressive anorexia and weight loss, vomiting, anemia, weakness and a palpable epigastric mass. This, unfortunately, is the picture of the late case usually too far advanced for hope of cure. No more than about half of all gastric carcinomas are considered operable at the time they are seen and only about one fourth of those operated on can be resected. Both of these facts bear mute testimony to the tardiness of diagnosis. The medical officer must maintain an eternal vigilance and a high clinical index of suspicion when confronted with individuals over thirty-five complaining of gastric symptoms. Loss of postprandial satisfaction, some fullness, belching, nausea, mild abdominal discomfort and some weakness are among the early symptoms. Achlorhydria is common but it must be remembered that 40 per cent of these patients will show some free acid and in a few even hyperacidity will be found. Full use of the x-ray and the gastroscope will prove invaluable in arriving at an early diagnosis.

## GASTRO-ENTERITIS

The symptom complex of acute abdominal cramps, nausea, vomiting and diarrhea designated as gastro-enteritis is in most instances attributed to some dietary indiscretion and then ignored from the etiologic standpoint. Many of these cases result from the ingestion of food or water contaminated with any of a number of infectious organisms. It is to be expected that under the conditions of field duty both sporadic and epidemic outbreaks of gastro-enteritis and food poisoning will be encountered despite all precautions.

Accurate *diagnosis* requires careful stool cultures and serum agglutination tests. In this respect, thought must be given to infections with the Salmonella group of bacteria whose importance lies not only in the fact that they may mimic in their clinical manifestations some intra-abdominal surgical emergency, but also because they may produce a typhoid-like state.

One of the newer chemotherapeutic agents, sulfanilylguanidine, promises to be of some value in the *treatment* of these infections.

## DYSENTERY

Included under this general heading are *bacillary dysentery*, *amebic dysentery* and *idiopathic ulcerative colitis*. All are characterized principally by lower abdominal pain, frequent bowel movements, tenesmus and the passage of mucus, pus or blood. In their chronic forms all are further characterized by spontaneous remissions and exacerbations. In each there are ulcerative lesions of the large bowel usually visible through the sigmoidoscope.

**Bacillary Dysentery.**—Acute bacillary dysentery is looked upon today as a systemic disease caused by *B. dysenteriae* in which the pathologic lesions of the bowel are merely local manifestations. In keeping with this concept, meningitic, pneumonic and agranulocytoid forms of the disease have been described indicating that at times the extracolonic manifestations may dominate the clinical picture. The disease is generally self-limited, running its acute course in seven to ten days. The *chronic form* is a progression of the acute stage in which the patient recovers partially or temporarily only to suffer periodic remissions and exacerbations. *Diagnosis* rests

upon the isolation from the bowel or stool of any of the strains of *B. dysenteriae* and the demonstration of agglutinins in the blood in relatively high titer. *Prophylactic immunization* has been attempted using a polyvalent vaccine for active immunization and a polyvalent serum for passive immunization during epidemic outbreaks.

*Treatment.*—Antidysentery serum and immunotransfusions have been the therapeutic mainstays for the active form of the disease but remarkable effects are now being reported from the use of the new intestinal sulfonamide, sulfanilylguanidine.

**Amebic Dysentery.**—In contrast to the bacillary type, amebic dysentery has a much longer incubation period and a less acute onset. The ulcers are discrete, have undermined edges and are surrounded by hemorrhagic halos. In the absence of secondary bacterial infection, the intervening mucosa is not acutely inflamed and there is no purulent exudate. The *diagnosis* must rest on the demonstration of *Endamoeba histolytica* in the stools or tissues. The methods available for identification of the amebae are the microscopic examination of unstained and stained smears of the feces, the cultivation of amebae from the feces, the examination of sections of the affected tissues removed through the sigmoidoscope and the complement fixation test.

*Treatment.*—Several amebicidal drugs are available which, if properly employed will eliminate infestations with *E. histolytica* in the vast majority of instances. The most useful of these drugs are chiniofon (yatren), vioform, carbarsone and emetine hydrochloride. Attention has recently been called to the excellent results from the use of a combined method of drug therapy consisting of a ten day course of carbarsone, 0.25 gm. before breakfast and supper daily, and 250 cc. of a 2.5 per cent chiniofon (yatren) solution as a retention enema every other day.

#### CHRONIC IDIOPATHIC ULCERATIVE COLITIS

As its name implies, this disease is of unknown etiology. Its *diagnosis* rests primarily upon the exclusion of chronic bacillary dysentery and amebiasis. *Treatment*, of necessity, is nonspecific and every measure designed to improve the mental status and the general state of health is employed. Increasing

attention is being given to vitamin deficiency correction, nutritional maintenance and the removal of possible food allergens. Local therapy in the form of rectal instillations has been largely abandoned. To date the currently available sulfonamides have proved disappointing.

### SIMPLE CONSTIPATION

The "CCC" pill of the last war is legendary. That there be no cause for its reglorification is essential. Excluding constipation due to anatomic derangements of the colon or to anorectal disease, most cases are habitual and are associated, as a rule, either with an atonic or a spastic colon. Cathartic and enema addictions are common.

**Treatment.**—Proper treatment requires courage, patience, strength and perseverance on the part of both the patient and physician. An explanation of elementary colon physiology and hygiene is invaluable in bolstering the patient's morale and enlisting his intelligent cooperation. Drastic cathartics, enemas and colonic irrigations must be summarily discontinued, but occasional overnight rectal instillations of vegetable oil (3 to 4 ounces), lactose, and small doses of magnesium oxide during the initial period of readjustment are helpful. *Proper habit formation* is a basic prerequisite if the disturbance is to be successfully corrected. Rest, sedatives, antispasmodics and lubricants are required for the spastic colon; the addition of fruits and artificial mucilaginous bulk producers (mucilose, konsyl) to the basically smooth diet used in all types is valuable in the type with an atonic colon.

### "CATARRHAL JAUNDICE"

The syndrome of painless jaundice in a young person shortly following an upper respiratory infection or a gastric upset characterized by anorexia, nausea, vomiting and possibly diarrhea, is well known. The etiology of this so-called "catarrhal" or "infectious" or "hepatocellular" jaundice is still undetermined. Increasing evidence indicates that in all probability it is due to a filtrable virus. Several observations suggest that it is spread by droplet infection or by contamination of food, water or milk. The importance of the disease lies both in the

epidemic proportions it may assume, particularly amongst men living in barracks or in the field, and in the serious liver injury that may ensue. The need for infectious precautions is suggested by its possible etiology and its epidemic potentialities.

**Treatment.**—Treatment must be nonspecific, with emphasis placed on hepatic protection. In the light of recent work, the latter is best achieved by a diet high in protein and carbohydrate and low in fat, fortified additionally by vitamin concentrates, particularly the B complex. Bile drainage to help clear the bile channels and bile salts to effect choleresis are valuable in the later stages when the ductal obstructions begin to clear.

**Weil's Disease.**—Under this category passing mention must be made of Weil's disease (leptospirosis icterohaemorrhagica). It is well to remember, however, that jaundice is exhibited by only about half the patients with this disease. The diagnosis cannot be made on clinical evidence alone and must be confirmed by at least one of the following methods: first, the demonstration of the leptospiras in the blood or urine by means of darkfield examination; second, the injection of blood, urine or spinal fluid into a guinea pig with the subsequent production of typical lesions and recovery of the organism; third, the demonstration of specific antibodies in the blood either by means of the Pfeiffer reaction or by direct agglutination with a known strain. The *prophylactic treatment* with immune horse serum in countries where the disease is endemic has been successfully used. In the treatment of patients with *active* involvement convalescent serum and polyvalent immune horse, goat and rabbit serum have all been found effective.

#### CHOLECYSTITIS

**Acute Cholecystitis.**—*Immediate Operation Versus Initial Period of Observation.*—The management of acute cholecystitis, a condition that is nearly always due to obstruction at the outlet of the gallbladder by calculus, has become a controversial problem. Opinion is sharply divided between those who advocate immediate operation in all cases and those who still cling to the conservative policy of delay. It must be admitted

that the lowest mortality has been achieved by those who operate within forty-eight hours of the onset of symptoms. The routine application of this procedure to all cases, however, is subject to several serious objections. It would result in a greater number of inaccurate diagnoses, an incomplete operation in many instances, and a poor operative state on the part of the patient because of the sacrifice of proper preoperative study and preparation. Of far greater importance is a wholesome appreciation of the gravity of the condition, the uncertainty of its course, and the frequency with which serious complications occur. Once these facts are realized the imperative need to immediately hospitalize every patient becomes apparent.

There is more or less general agreement that immediate surgery is indicated whenever there are signs of imminent perforation or actual perforation with generalized peritonitis. In all other cases an initial period of observation is desirable during which close watch is kept on the pulse, temperature, white blood cell count and the local abdominal signs. At the same time fluid and chemical balance is restored and measures are instituted designed to protect the liver and prepare the patient for possible operation. The acute process is permitted to subside spontaneously unless there is clinical evidence of progression during the first twenty-four to thirty-six hours of observation or failure to show any tendency toward subsidence after thirty-six to forty-eight hours. In these events operation is no longer delayed. When all evidences of the acute inflammation have disappeared the patient is studied. Detailed procedures such as cholecystography or biliary drainage are never undertaken until clinical subsidence is manifest. Once the diagnosis is proved, the patient is prepared for cholecystectomy which, as a rule, is performed before discharge from the hospital.

**Chronic Cholecystitis.**—The *flatulent indigestion* with which chronic cholecystitis has been traditionally associated has been adequately shown to be nonspecific and just as characteristic of many other intra-abdominal disturbances. The occurrence of *biliary colic* along with the dyspepsia is the one feature of real value in fixing suspicion on the gallbladder as

the cause for the symptoms. There is a wholesome and widespread skepticism as to the role which the noncalculous gallbladder plays in the production of symptoms. Every effort, therefore, is expended to establish whether or not *calculi* are present, in addition to estimating the degree of function of the organ. The best means at hand for demonstrating the existence of gallstones consists of cholecystography, biliary drainage and stool examination. In the latter two, close scrutiny is made for cholesterol crystals and calcium bilirubinate pigment.

The only adequate *treatment* for the symptomatic stone-bearing gallbladder is cholecystectomy, with exploration of the common duct whenever indicated.

### PANCREATITIS

**Acute Pancreatitis.**—The diagnosis of diseases of the pancreas continues to be one of the most difficult problems in internal medicine. Acute pancreatitis is now recognized as consisting of two main types: first, the *hemorrhagic, necrotic or suppurative* in which the attacks are sudden and violent with severe, agonizing pain in the epigastrium radiating to the left and frequently to the back, signs of shock and collapse, marked epigastric tenderness, cyanosis, leukocytosis and glycosuria; second, an *edematous or interstitial* type which is milder and much shorter in duration. The striking difference between the two types and the need for their differentiation is the likelihood of the edematous type subsiding spontaneously after two or three days. Determinations of pancreatic enzyme concentrations in the blood serum, particularly lipase and amylase, have proved of invaluable assistance in establishing a diagnosis.

Opinion is rapidly crystallizing around the belief that *operation* should be delayed until the more acute stage has subsided. At operation a cholecystectomy is usually done and, when indicated, drainage of the lesser peritoneal cavity.

**Chronic Pancreatitis.**—Many individuals of middle or later life who present vague upper abdominal syndromes are unquestionably suffering from a chronic pancreatitis. Suspicion of disease of this organ should be aroused by the demonstration of alimentary glycosuria, abnormal amounts of un-

digested fat or starch or meat fibers in the stool, and an abnormally high concentration of serum lipase or amylase.

*Treatment* is largely dietary and symptomatic. A high carbohydrate, low fat, maintenance protein diet is given along with substitution therapy in the form of pancreatin, raw pancreas or pancreatic juice.

### GASTRO-INTESTINAL NEUROSES

The dominant gastro-intestinal symptoms of the neuroses consist of: *subjective sensations* such as abdominal pain usually of a vague, nondescript, indefinitely localized type, heartburn and nausea; *disturbances of motor function* as typified by vomiting, diarrhea, constipation and belching; *secretory disturbances* of the nature of gastric hypersecretion or excessive colonic mucous discharge; *disturbances of appetite* in the way of anorexia, bulimia or a hunger for unusual foods. Such recognized *junctional alimentary disturbances* as aerophagia, nervous diarrhea, mucous colitis and the irritable colon syndrome are often displayed.

Unfortunately, the same clinical features are likewise manifested by many of the organic gastro-intestinal diseases. It is well, therefore, to consider every case as being possibly of organic origin, for often the neurosis hides or is accompanied by a focus of inflammatory or neoplastic disease. A preconceived conclusion, a hasty guess, an incomplete examination, a prejudice against the individual who continually reports on sick call with seemingly minor complaints are all fraught with danger. The patient recognizes only the outward manifestations of his malady and seeks the physician for relief of symptoms which to him are evidently gastric or intestinal in nature. Thorough and patient study, kindly interest, reassurance and sympathetic advice are required for the rehabilitation of these individuals.

### SUMMARY AND CONCLUSIONS

Disorders of the digestive system will form a large part of the ailments that the medical officer will be called on to treat in military practice. A great number of these will have had their inception long before the individual entered military service.



Closer attention to the alimentary history and the ready use of all indicated special studies at the time of induction may possibly avoid the acceptance of many persons who are otherwise considered fit for active duty. From the viewpoint of digestive tract function, only those who are well and who may be expected to remain well should be permitted to filter through the barrier of the entrance examination.

The most important respect in which gastro-intestinal problems in civil practice differ from those in military practice is in the means of instituting adequate diagnostic and therapeutic measures. An invalid with digestive disease will never become a blitzkrieg soldier and a dyspeptic soldier or sailor is a liability. It is essential, therefore, that such individuals either be rendered physically fit for active duty or be discharged from such duty. This requires, in most instances, removal of the individual to a hospital or to zones where fixed installations of that character are available. Only at such places can thorough studies and adequate care be instituted and proper disposition finally made.

In the last analysis, to paraphrase the Napoleonic observation, an army travels on its stomach and it is our duty as physicians to insure a smooth and uninterrupted journey.

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